SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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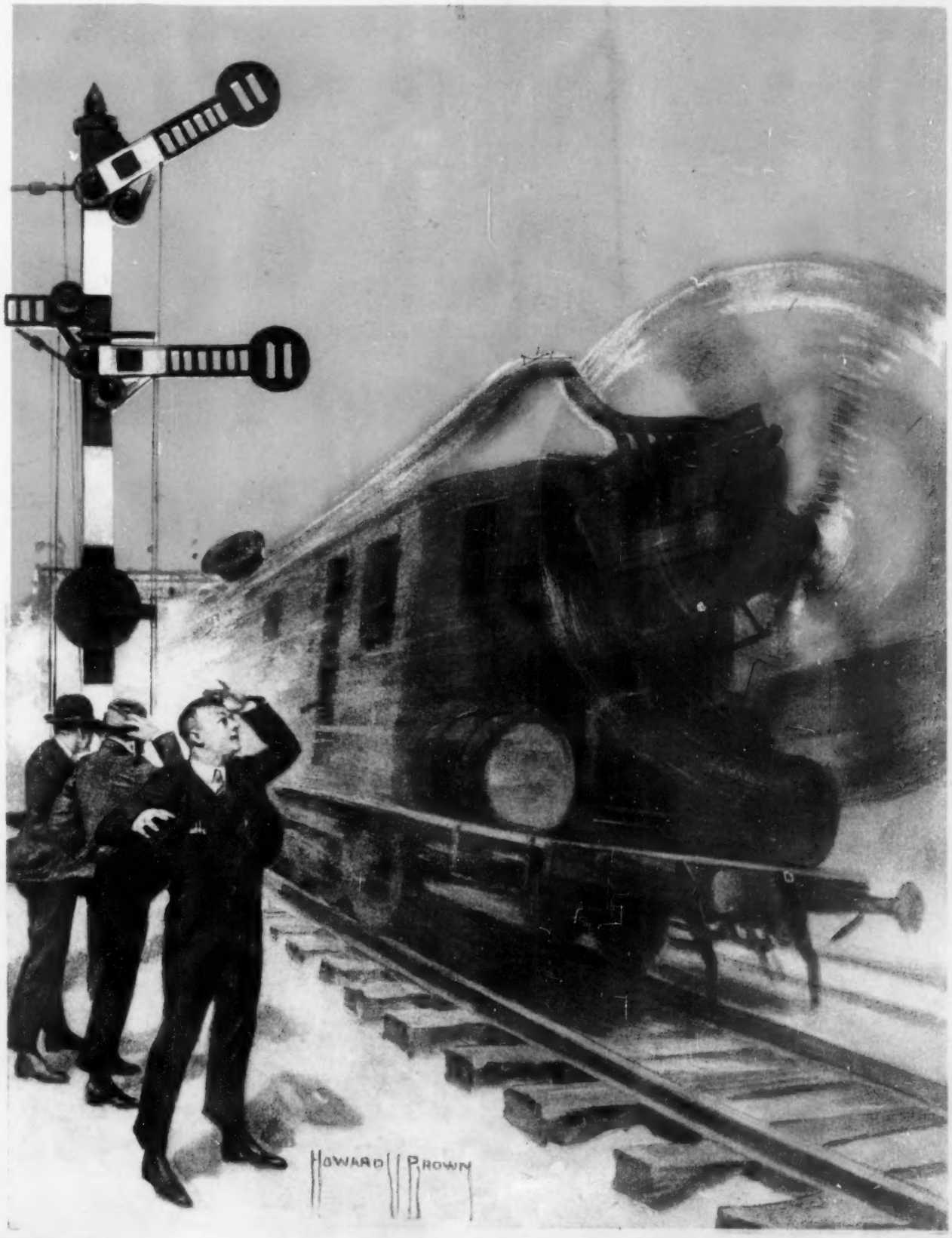

HIGH-SPEED RAILROADING WITH AIRPLANE ENGINES AND PROPELLERS—[See page 191]

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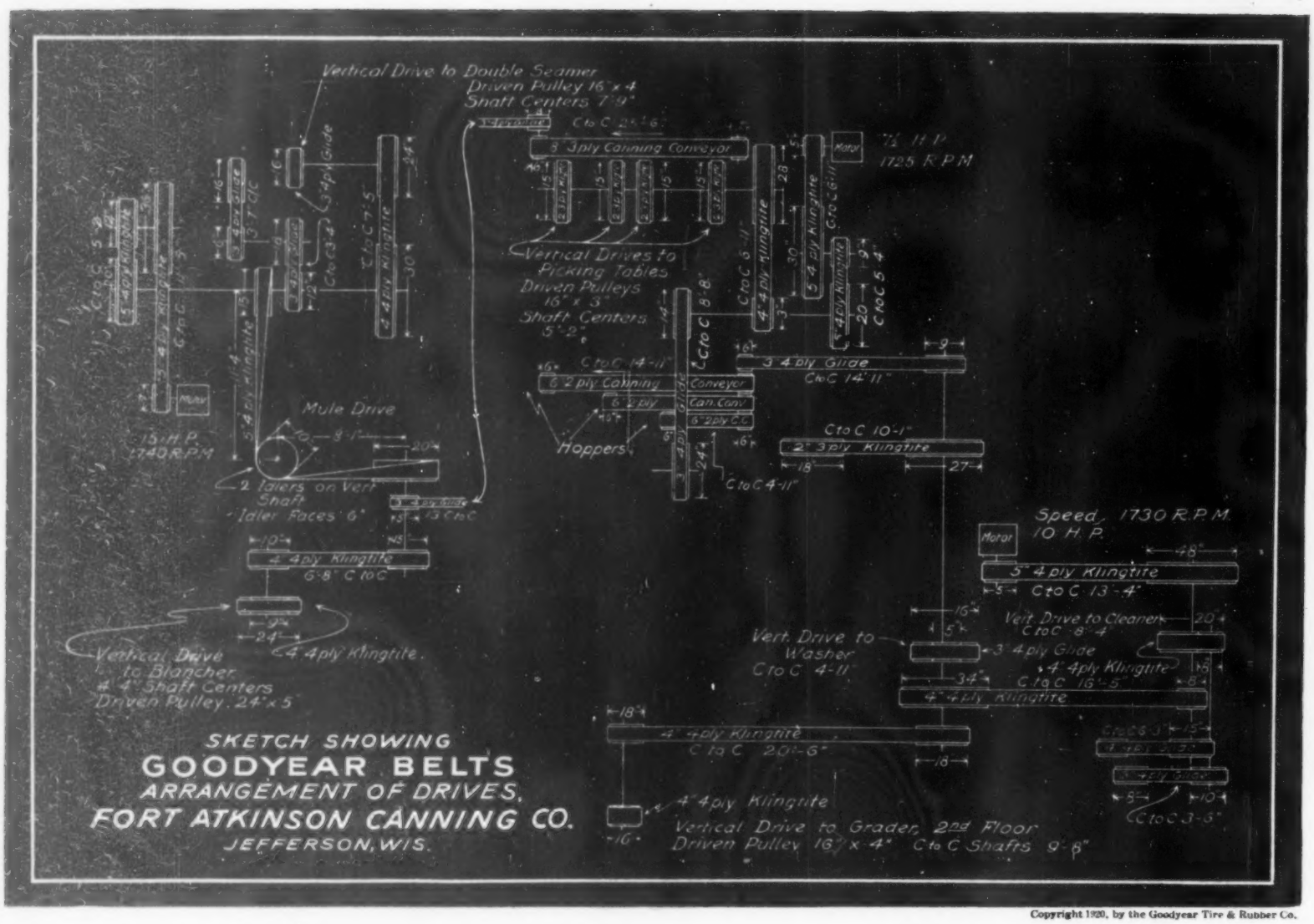


SKETCH SHOWING
GOODYEAR BELTS
ARRANGEMENT OF DRIVES.
FORT ATKINSON CANNING CO.
JEFFERSON, WIS.

An Idea, Our Good Name—and the G. T. M.

They had never used a Goodyear Belt. Their experience with the belting they had in their parent plant had been generally satisfactory. But the Fort Atkinson Canning Company did know Goodyear reputation for quality—knew it by the willing testimony and the demonstrated experience of other concerns the country over who were reporting notable successes with Goodyear Belts on every kind and condition of drive.

And the plant analysis idea proposed by the G. T. M.—Goodyear Technical Man—struck them as the logical way to insure the right belt for every duty. They had opportunity to test the principle of it thoroughly in a study of their new plant's belting requirements. They had the G. T. M. make the study.

So they specified 100% Goodyear equipment—transmission belts, conveyor belts, steam hose, water hose—for their new cannery at Jefferson, Wis., all on the basis of the G. T. M.'s plant analysis, and their confidence in Goodyear products.

The Jefferson plant is an efficient linking of different transmissions and conveyors. No one type of belt, however well adapted to one form of duty, could be depended on to fulfill with equal capacity all these varied demands. An expert analysis that insured the full effectiveness of every drive in relation to the entire unit appealed to the superintendent as the only right solution of the power problem.

Note the belts specified to their particular uses; for the light drives, where the conditions are small pulleys run at high speed and uniform load, Goodyear Glides; for general transmission and moderately heavy duty, Goodyear Klingtite has been used. Width, plies and type are specified to the service required. The very natures of the Goodyear Belts employed meet the peculiarities of the situation. For instance, the belt on the canning conveyor, due to its particular construction of cover, fabric and friction, insures against the action of acids encountered in the raw material it carries.

The unfailing performance of these Goodyear Belts substantiates the plant analysis method of applying belts to the specific service. Their freedom from belt troubles—no slipping, no stretching to an appreciable amount, which usually causes an interruption in production in order to "cut out" and take up the slack—is their own best service assurance.

Both Goodyear analysis and Goodyear Belts are at your service. The G. T. M.'s expert study of either a single drive or a complete plant installation is without obligation on your part. For further information about the Goodyear plan of plant analysis and the G. T. M., write to the Mechanical Goods Dept. of The Goodyear Tire & Rubber Co., Akron, Ohio,

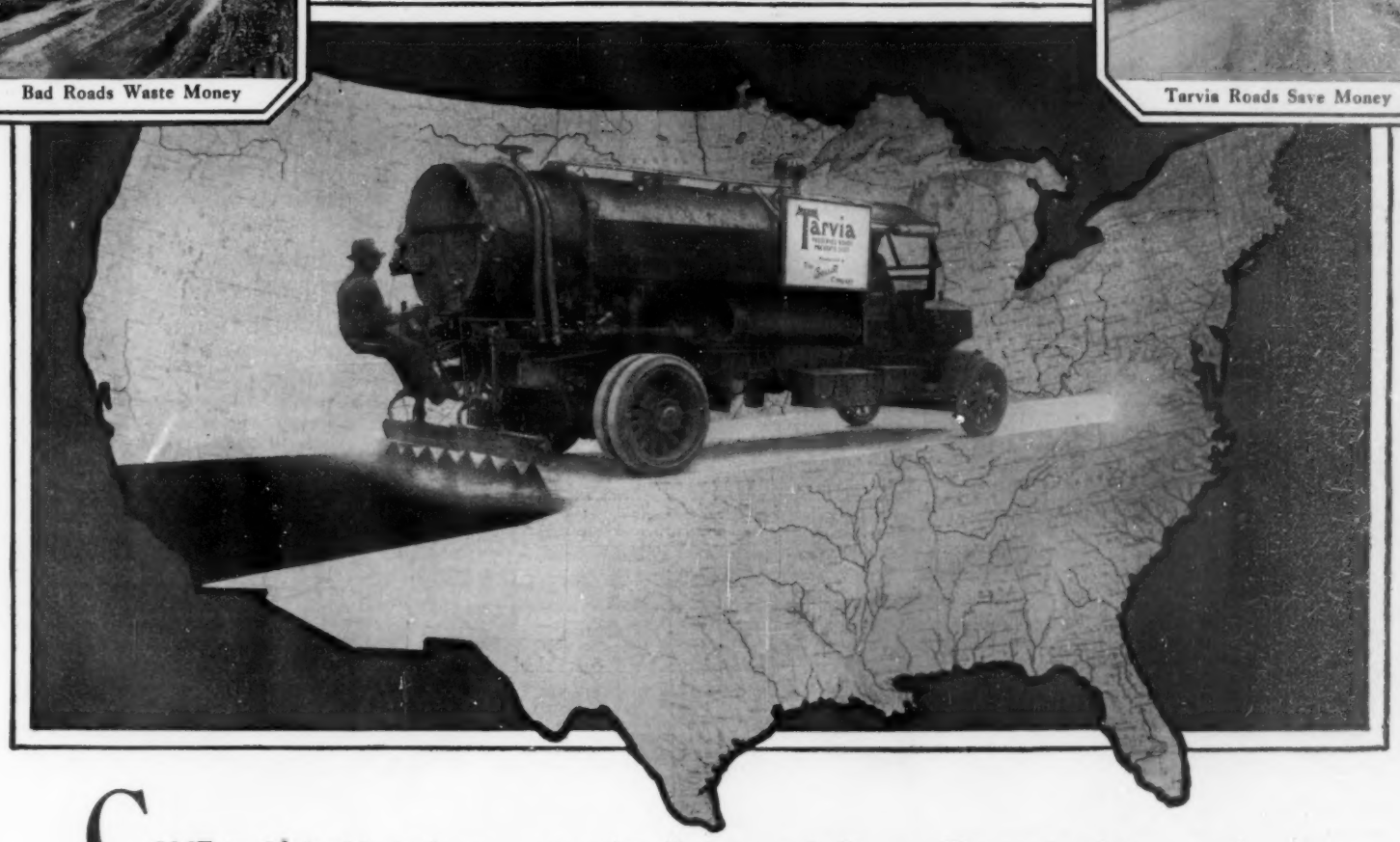
BELTING · PACKING · HOSE · VALVES

GOODYEAR

Bad Roads Waste Money

Put your town on the good roads map this year

Tarvia Roads Save Money



COME to think of it, is there anything so expensive to a community as *bad roads?*

Bad roads slow up business, lower land values, make markets inaccessible, isolate neighbors, cost a lot of money and waste much more.

People tolerate bad roads year after year because they *think* good roads cost too much.

But good roads *are not* expensive, if they are built in accordance with a well-thought-out program, somewhat along these lines:

Consider –

1. The traffic the road will have—
2. Its initial cost—
3. Cost of maintenance—
4. Durability—
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6. What "Barrett Service" can do for you.

Thousands of towns and cities all over this country, have had their road problems economically, satisfactorily and quickly solved by the use of this popular road material.

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Tarvia

Preserves Roads~Prevents Dust

Special Service Department

In order to bring the facts before taxpayers as well as road authorities, The Barrett Company has organized a Special Service Department, which keeps up to the minute on all road problems.

If you will write to the nearest office regarding road conditions or problems in your vicinity, the matter will have the prompt attention of experienced engineers. This service is free for the asking. If you want *better roads* and *lower taxes*, this Department can greatly assist you.

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SEVENTY-SIXTH YEAR

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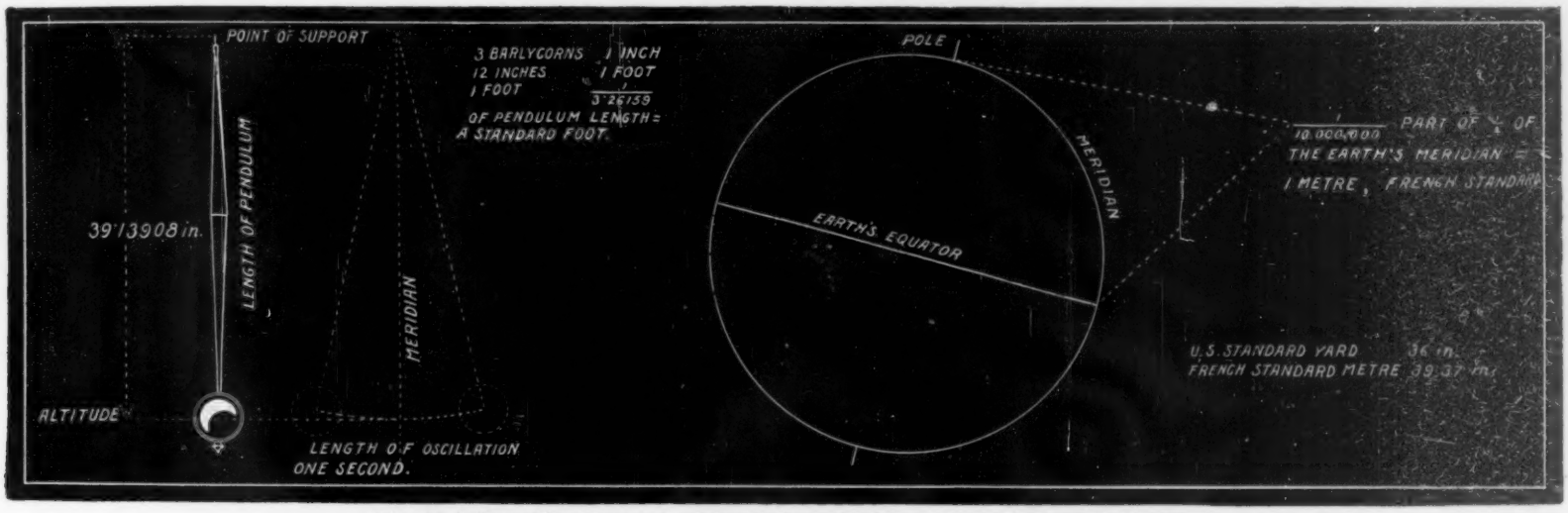

The physical considerations that go into the determination of the standard yard and meter

Why Is It A Yard?

THE standard unit of linear measurement in the United States is the yard. The system is based, in last analysis, upon the fact that the force of gravity is constant for a given point on the earth's surface, which in turn implies that a pendulum which oscillates a certain number of times in a given period is of constant length. Within a receptacle from which the air has been exhausted to form a vacuum, and which has been placed at a known altitude, latitude and longitude (in the Tower of London), a pendulum beating seconds is made by English law to represent, with 1/3.26159 part of its length, a measure which shall be known as the standard foot. From this by multiplication and division the whole system of English linear measurements is established. The arbitrary yard, originating in England and defined as the distance between two fine lines engraved on gold plugs inserted in a steel bar, has been applied in the United States and forms the basis of all our systems of measurements. Copies of both standard yards are preserved in London and at the National Observatory in Washington, our yard being one one-hundredth of an inch longer than the English one.

On the other hand the French have, by a very minute survey of the length of an arc of the meridian from Dunkirk to Barcelona—the latitude of each place being determined by exact observation—computed the length of a quadrant of the meridian. It is now known that this determination was itself subject to a certain error; so that when it was decreed by the French law that the ten-millionth part of this length shall be regarded as the standard French meter, the system of measures thus established had not quite so firm a foundation in natural fact as was supposed. Nevertheless, from this alleged ten-millionth part of the quadrant, by multiplication and division, an entire system of linear measurement has been formed. The meter is 39.37043 inches in length. It will be seen that this system and equally the English one are based upon the measurement of the earth and the calculation of sun time.

The human foot has from the earliest times been used as a standard of measurement. The Roman version was 11.62 of our present inches, with a pace equal to five feet, and a mile, or *mille passus*, comprising 1,000 paces, as its name indicated. This use of the human foot for measuring purposes is what gives the unit its name in English and many other tongues. But the foot is not the only part of the human body that has been used as a standard; we all recall the 16-hand horse, an expression meaning that the horse is 16 hands high at the shoulder. A hand, at least in this connection, is supposed to be four inches across the palm. Then there is the span, measuring nine inches from the end of the thumb to the end of the little finger, and to which most strongly attaches that tradition of invariance among different individuals which is more or less explicitly claimed for all such measurements. Also there is the fathom (six feet), supposed to represent the space a man can cover with his arms extended; the first joint of thumb or index finger was always an inch measure for "old-fashioned" folk; while it is "just a yard" from the tips of the fingers to the point of the chin with a lot of up-to-date ladies who do their own sewing in 1920.

In the struggle for accuracy, which seems to have become one of the fetishes of the day, man has never been satisfied with approximate measurements. But to have anything like the ideal accuracy which this remark implies he must first have a standard that remains the same at all times and in all places; one that is fixed by law and custom, and that is accessible to all users alike. It is not very easy to attain such a standard, although it is easy enough to become dogmatically chesty, if not self-opinionated and egotistical, with those segments or multiples which we call miles, rods, yards, feet, inches or fractions thereof when once such a standard is found. The Englishman was forced to take the rather formidable appearing 1/3.26159 of the length of the seconds pendulum in the Tower of London as his standard foot, the length of the pendulum being to his mind the most constant thing known—so constant that he thought he could set ten million pendulums oscillating, one replacing the other, upon the same meridian and at the same altitude in the Tower, and that all of them, to beat seconds, would be absolutely the same length.

Yet the Frenchman's meter system, based on a meter representing one ten-millionth part of the estimated distance from the pole to the equator, has so impressed many of our mathematicians that there has been much agitation about establishing this system in place of the more familiar English one. It is of course true that a system of measures can be built up on any foundation, and that the 11.62-inch foot of the Roman Emperor is as sustaining to the system as is the length of a pendulum, providing law and custom provide the bed rock of stability.

When we consider that Troy weight, used for weighing gold, silver and all precious things, is based upon the heft of a grain of wheat, well-dried, and from the middle of the ear, on the basis of 24 grains to a pennyweight; that three barleycorns represent one inch; that the human foot is still widely used to measure—not merely to name, but actually to measure—a linear foot; that a yard is one-half the space covered by a man with extended arms, and gets its name from a spar slung to a mast; and so on through all the units of measurement; when we consider all this, we shall realize the need of a constant never-changing measure standard.

Custom has had such strong influence upon measurements in the past that we only need to cite a single unit as an example of the possible confusion in the minds of our polyglot population—the mile. This, as Americans understand it, is 1760 yards; but the Swedes know a mile as 11,700 yards, the Russians as 1165 yards, the Italians as 1614, the Scotch as 1984, the Irish as 2240, and the German as 5285 or 8805 yards, according to whether it be understood as a "short mile" or a "long mile." Then we have the league, about 5280 yards; the nautical mile of 2028; etc., etc. It makes no difference what our alien calls his mile; when he understands the meaning of our word he does so only as he knows the thing our mile suggests in his own language—which we see is almost always something different.—*W. M. Butterfield.*

Some Economies for Welded Ships

THE economies which it is hoped to achieve by welding ships are far from beginning and ending with the saving of time and labor in riveting. It is pointed out that a 10,000-ton ship costing $1,900,000 now costs but $83,000 to rivet, and that if electric welding only promises to modify this amount, no very substantial gain will be obtained. Many other benefits will, it is hoped, follow the change from riveting to welding, and tests have in view the abolition or at least the lessening of the transportation from the rolling mill to the fabricating plant when the latter is not at the shipyard; the template makers' work; the markers' work; the punching, and much of the work of the fitters and bolters who flog and pull the pieces so as to make them fit when on the ways. It is estimated that, taking into consideration all the above items, a saving of one month in the time of construction and of no less than $38 a ton in the cost of steel structure may be made, the total saving cost being $97,500 on a 10,000-ton vessel.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Present and Future Prospects of Our Merchant Marine

THE operations of the Shipping Board are so complicated and are being carried out on such a vast scale that it is rather difficult for the average citizen to understand at any time just where we stand, what has been done, and what we intend to do. Considered as a commercial proposition, the problem is confusing because of the fluctuation in the price of ships and in the freight rates and the uncertainty as to just what Congress will determine to do in the matter of the selling of ships, and the flag under which vessels which are sold will operate.

The latest statement by the Emergency Fleet Corporation of the Shipping Board shows that in 1917 we launched 106 ships representing a total of 708,970 deadweight tons. In 1918, the Corporation launched 812 ships, or a total of 4,244,126 deadweight tons. The record year came in 1919, when we launched 1,065 ships, representing a total deadweight tonnage of 5,982,277 tons. Of these total launchings, the Corporation delivered in 1917, 49 vessels, amounting to 302,115 deadweight tons, in 1918, 532 vessels of 3,026,006 tons deadweight, and last year, when we launched 1,065 ships, there was actually delivered 1,181 ships of a total tonnage of 6,385,123 tons deadweight. There remains of the war construction program, 534 ships of 3,661,767 deadweight tons, which will be completed and delivered by August of the present year.

In addition to this, we either purchased or contracted with Japan for the building of 45 ships of 372,023 deadweight tons. Of these we have actually received from Japan and have now in service 18 ships of 148,323 deadweight tons.

Summing up these activities and the taking over of German and Austrian vessels, we find that the United States possesses 8,700,917 tons of steel ships, 1,799,123 tons of wooden ships, 63,000 tons of composite and 10,000 tons of concrete ships, making a total tonnage of 10,573,040 deadweight tons. Adding to this the 3,661,767 tons to be completed in 1920, we get a grand total of 14,234,767 deadweight tons, or 9,489,511 gross tons.

Now, during the period covered by the operations of the Shipping Board, we have lost through accidents at sea, by reconveyance to former owners or by sale 194 ships representing 1,274,371 deadweight tonnage. Moreover, some of the ships now in operation will be sold for use by foreign flags. Nevertheless, the fleet as a whole, representing 1688 ships, of say in round numbers 9¼ million tons deadweight or 6¼ million tons gross, will be operated under the United States flag as a permanent merchant marine, and will be available to serve the trade routes of the world.

Now it must be clearly understood that this fleet is a cargo fleet pure and simple, at least so far as the ships which were built during the war are concerned. We built absolutely no passenger tonnage, all the increase in passenger ships being due to such vessels as were taken over from the enemy. At present we are building 26 new passenger ships which should be delivered this spring. The War and Navy Departments have turned over to the Shipping Board 27 ex-German passenger ships, but these having been made into troop ships are not in any condition to be used for passenger service, and will not be until they have been re-conditioned. Thus far only one of these, the "Moccasin," of 3,100 tons gross, has been re-conditioned, and she is now in the South American trade. The outstanding problem, however, of the whole question is that of policy, and particularly with respect to ownership and operation. Shall the ships remain the property of the Government and be operated by the Shipping Board or by private concerns under charters granted by the Shipping Board, or will it be better policy to sell the ships outright to the highest bidders under long-term payments, abolishing the Shipping Board and leaving the future of our merchant marine entirely to private initiative? Or, as a last alternative, shall the Government retain its new merchant fleet, leaving it under the control of the Shipping Board to be operated for the largest profits that can be obtained and in unrestricted competition, not merely with foreign shipping, but our own?

The SCIENTIFIC AMERICAN is strongly of the opinion that one of the outstanding lessons of the war is the futility of Government ownership and operation of public utilities or great industrial and commercial enterprises of any kind whatsoever. The ships should be sold in the open market to the highest bidder, with the proviso that, except in special cases, they shall not pass under a foreign flag. They should be sold for a certain and considerable cash percentage of the price, the balance of the payments to be made at stated intervals. Furthermore, it would be futile to attempt to sell the ships at their original cost, which today is far above the price for which shipping is being constructed in the leading shipyards of our competitors. Last and by no means least in importance, is the crying need for a revision of our navigation laws and the removal therefrom of certain very burdensome and entirely unnecessary restrictions.

Geographical Blind-Man's Bluff

ONE of our contributors recently suggested that the motor tourist frequently enters a town with no idea of where he is, and that a sign giving the name of the place would be appreciated. It does seem a bit out of the way for every insignificant hamlet to assume tacitly that introduction of this sort is not required. But we have a far worse grievance to air than that of the wandering autoist.

We do not really have to know the name of the town through which we are passing. We can get in and out again; we can secure a meal and a supply of gas; we can even take a night's lodging and have the car tinkered, without bothering about the local designation employed by the postoffice. But when we get a letter we are expected to answer it, and to do this we must know whence it came. Yet once the average communication from abroad gets detached from its envelope, the chances are good that we will never find this out.

Foreign correspondents may have the same grievance against us. They may get letters dated from Washington and Troy and Hicksville, not knowing in the one case which Washington or which Troy is meant, or unable in the other to locate Hicksville at all. But we doubt this. The American letterhead, printed or written, that fails to indicate the state is the exception; while with writers of other lands, the omission of a line telling where in the world the writer's town is located varies in frequency with the utter inconsequentiality of that town.

A man writing from St. John, New Brunswick, for instance, is pretty apt to add "N. B." to his date line. But the citizen of St. John in Antigua or the Isle of Jersey is almost certain to put only "St. John, Oct. 6" at the top of his screed. When a letter is dated from Grimsby-Harcourt-on-Humber, one is fairly safe in assuming that it comes from England rather than from one of her far-flung colonies; and the man who writes from the original London must put, after the name, some such cabalistic token as "W. C. 16," thus locating himself in London, England. But where is Grimsby, and where is London, writ down without further details?

Sometimes the case is even more desperate. Take the letter which inspired this tirade, and which came from Cocanada. Now Texarkana is partly in Texas and partly in Arkansas, and if we were to follow this system through, we might look for Cocanada in the spot where Cochin China adjoins the Dominion of Canada. But when this clue failed us, there seemed nothing better than to search in the index of Herr Steiler's admirable atlas. This we did; and after poking about on the map to which the reference assigned Cocanada without finding any trace of the name, we consulted another and less generally accessible volume. Here we learned that Herr Steiller had committed a misprint, and that our town of the musical name, instead of lying in the heart of the Tibetan Desert as his index implied, was located on the eastern coast of India.

Another curious aspect of this phenomenon of incomplete address is that the chances of its occurring seem in direct ratio with the probability that the resident of the town in question will never have occasion to write elsewhere than abroad. The best part of a Liverpool merchant's correspondence must be domestic, so he carefully puts "England" at the head of his letter. But the gentleman who writes from a place 100 miles distant from the nearest white settlement, and whose local correspondence can hardly be in greater ratio than one in 500 of all the letters he writes, invariably, it seems, leaves off everything save the name of his postoffice. We have got so that we can guess correctly in nine cases out of ten whether a given place is in South Africa or New Zealand, but that covers only one corner of the field—though to be sure in New Zealand it covers one of the worst offenders. But we cannot always guess right. Rio Janeiro is in Brazil, by confession of the printer, just as Buenos Aires is in Argentina; but the keeper of the general store in San Juan never deigns to tell us which of the myriad San Juan's is his, while the resident of Urubicha or Banjoewangie displays a calm and touching confidence that we know where to place him or can find out. And we can't get our Uncle Samuel to help us out of these puzzlements; if we try it, he hands us back our letter the next morning, neatly stamped "Returned for better address."

A Department of Air

THERE has seldom come before Congress a question calling for more careful consideration than that of the formation of a separate Department of Air. In its favor is the fact that it will make for concentration and the budget system as against the institution of a dozen or so of separate branches for the Army, Navy, Postoffice, Geological Survey, et cetera, with all the duplication of effort, greater costs, and clash of interests which that would involve. Looked at from these standpoints, the creation of a separate department seems to have everything in its favor. Against a single department, it is urged that the types of planes and the character of the service called for by the separate departments is so varied, that they each have so many individual problems to work out, that it would be impossible for any one single department to do equal justice to all. Possibly a way out of that difficulty would be for each department to have its technical representatives, familiar with its own special requirements, represented in the Department of Air in an advisory capacity.

A great advantage of forming a Department of Air would be found in its ability to take care of the interests of civil and commercial aeronautics. According to the bill now before the Senate, the director of the department would be authorized to establish aerial routes and to coöperate with states, cities and municipalities in the matter of building airdromes and acquiring landing fields to be used in common. It is most earnestly to be hoped that should the department be formed, every effort will be made to stimulate and not, as happened during the war, to repress private initiative and enterprise both in the design and construction of airplanes. Naturally, the Army and Navy Departments are opposed to the creation of a separate Air Department; but if they were proportionately represented in the Department, it seems to us that their interests could be amply covered, and that at the same time the total overhead charges due to many scattered and unrelated efforts would be enormously reduced.

Naval and Military

The Torpedo-plane.—The successes scored by the torpedo-plane in the North Sea, when the Germans used it successfully against merchant shipping, awoke the naval authorities to the great tactical value of this weapon against warships. Had the war been prolonged this form of offensive would have been used extensively against the German fleet. All of which must be gratifying to that gifted inventor, Admiral Bradley A. Fiske, who had already won great distinction as the inventor of the gun telescope—the foundation upon which modern gunnery has been built up.

Battle-Ships for Targets.—The highly efficient Bureau of Ordnance contemplates introducing a system of target practice for the Navy which will more closely simulate actual battle conditions. It is proposed by Rear Admiral Earle to take several obsolete ships and use them as targets running at full speed. They would be without crews, of course, and they would be steered by the new method of radical control which has been developed for airplane service. The advantage of this is that the target ships would pursue zigzag or even sinuous courses while under fire by firing ships. The advantage of such a system over the present method of towing canvas targets will be obvious.

"Drummers" on Warships.—There is almost an element of comedy in the suggestion that a limited number of commercial travellers be given transportation in British warships that are destined for foreign stations. We are told that the obligations of the Navy to promote trade will cease when the port of arrival is reached, for then these civilians are to be turned loose to look out for themselves. Just what their status will be aboard ship is not told us, or where they would berth or where they would eat. As members of the officers' mess and listening to a discussion of the latest intricacies of director-firing, they would surely feel like fish out of water. The proposal calls to mind the suggestion made a few years ago to use some of our fastest cruisers in the merchant service as mail and light freight carriers.

Unsung Heroism of the Seas.—Formerly there was a spectacular appeal in the ship of war which was denied to the ships that come and go carrying the commerce of the world. But the war has changed all that and the common merchant sailor has come into his own as a fearless and heroic character. This truth is forced upon our attention by the appeal which is being made to Americans (the appeal does not come from the other side) to contribute to the fund for British merchant seamen which is being raised in Great Britain and her colonies. The American Ambassador in London has said: "There is no more glorious page in the history of the war than that contained in their bravery and sacrifices. . . . They are the men who defied and defeated the base iniquity of the German submarine campaign, and it is not too much to say that without their brave devotion the war would not have been won." No less than 17,000 of these men were killed and 30,000 disabled in transporting troops, munitions and food for our own and the Allied armies.

Capital Ship Construction Abroad.—So far as we can learn there is no construction of capital ships being carried on at the present time among our Allies, with the possible exception of Japan. The French are doing practically nothing to complete the four powerful ships of the "Normandie" class which they had in hand in 1914. These ships, it will be remembered, were to carry twelve 13.4-inch guns in three turrets. This involved the unprecedented arrangement of mounting four guns in a single large turret. The work on these ships was stopped entirely during the war, and has not been renewed since the armistice. In fact, one of the ships, the "Bearn," has, we understand, been broken up. Italy has four ships of the "Morosine" type of 30,000 tons, mounting eight 15-inch guns. They were to have been laid down in 1914, but they are not being completed. The Japanese had commenced a ship of 32,000 tons, the "Nagato," at the time we entered the war, and it is believed that four of this class have been commenced or are contemplated. The "Nagato" is somewhat advanced, but little, if anything, has been done on the others.

Astronomy

Nova Aquilæ in 1919.—The new star that appeared in Aquila in June, 1918—the brightest nova seen in the past three centuries—waned from less than zero magnitude, when discovered, to magnitude 5.5 in November. During the first six months of the present year its brightness further declined to magnitude 7.5.

Polar Caps of Venus.—According to Mr. Edward M. Nelson, writing in the *English Mechanic*, polar caps were plainly visible on Venus last June in his 3-inch refractor, power 160. They are described as of intense whiteness, resembling that of the crater Aristarchus on the moon. A similar observation is reported from M. Flammarion's observatory at Juvisy, France.

The International Astronomical Union was instituted in Paris in November, 1918, and its organization was completed at the meeting of the International Research Council in Brussels last July. M. Baillaud is president and Prof. A. Fowler general secretary. Several committees have been appointed to organize international coöperation in various branches of astronomical work.

A French Abstracting Journal for Astronomy.—The *Bulletin Astronomique* of the Observatory of Paris has changed both its character and its title. Hereafter it will be known as *Revue générale des travaux astronomiques*, and will be devoted to the publication, in French, of brief abstracts of current literature relating to astronomy and geodesy. Authors are requested to abstract their own papers for the *Revue*, which will be issued monthly.

The Astronomical Society of France held its general meeting, the first since the outbreak of the war, June 1, 1919, and elected officers for the ensuing two years. Count A. de la Baume Pluvinel, who had held the office of president since 1913, delivered an address on the recent progress of astronomy. The new president of the society is M. Paul Appell. The Janssen prize for this year has been awarded to G. Bigourdan, of the Observatory of Paris, especially on account of his notable studies of nebulae.

Variability of Betelgeuse.—According to *l'Astronomie* this interesting irregular variable (Alpha Orionis) was increasing in brightness at the end of last year and was then 0.4 magnitude brighter than Aldebaran. A year previously it was passing through a period of diminished luminosity and in March and April, 1918, was of the same magnitude as Aldebaran. The variability of Betelgeuse was discovered by Sir John Herschel in 1840. Its light curve showed a high maximum October 16-21, 1902, when the star equaled Capella in brilliancy, while in the period February 11-18, 1911, it was slightly less bright than Aldebaran.

Is the Sun Passing Through a Nebula?—A curious hypothesis has recently been put forth in France by Col. Delauney to account for the 11-year sunspot period and various other phenomena of the solar system. The author finds that although the actual intervals between sunspot maxima are quite irregular, there is a certain symmetry between the years on either side of the maximum of 1788; the maximum of 1739 corresponding to that of 1837, the maximum of 1727 to that of 1848, etc. This observation leads to the suggestion that the sun is passing through a nebula consisting of a central nucleus and a series of concentric circular rings. Passage through the nebular matter gives rise to disturbances in the solar atmosphere indicated by a spot maximum. If the sun passed through the nucleus in 1788, its passage through the successive rings would occur at corresponding intervals before and after that year. Col. Delauney thinks that the mutual attraction of the solar system and the nebula would result in oscillations of the two back and forth. The passage of the sun through the nebula would generate heat, serving to keep up the output of solar radiation; while its periodical passages beyond the limits of the nebula may have been so prolonged in former times as to account for glacial periods. Several other details of the hypothesis appear in *l'Astronomie*, but need not be repeated here, as the idea is purely tentative and requires critical examination.

Engineering

Ash-Pit Sealed by a River.—An interesting feature of a recent power plant installation in western Pennsylvania is found in the arrangement of the ashpit. This is sealed by carrying down below the level of the Allegheny River adjoining; and the ashes will be removed from the pit by means of bucket conveyors.

Concreting a Big Bridge has recently been carried out in a novel manner at Columbus, Ohio. Although the structure is 678 feet long and consists of seven spans, the mix for the entire job was put in place by direct chuting. This result was made possible by the use of carefully worked out apparatus for the bulk handling of all ingredients, as well as of the mixed concrete.

Concrete Boiler-Room Settings.—A large factory in Brooklyn had used reinforced concrete in a small way about its boiler room for several years, with sufficiently favorable results to lead to its specification for a new boiler room, in the settings and the columns supporting the boilers. These columns are continuously exposed to severe heat. If this experiment turns out satisfactorily, engineers will have a considerable avenue of economy opened for power-house installations.

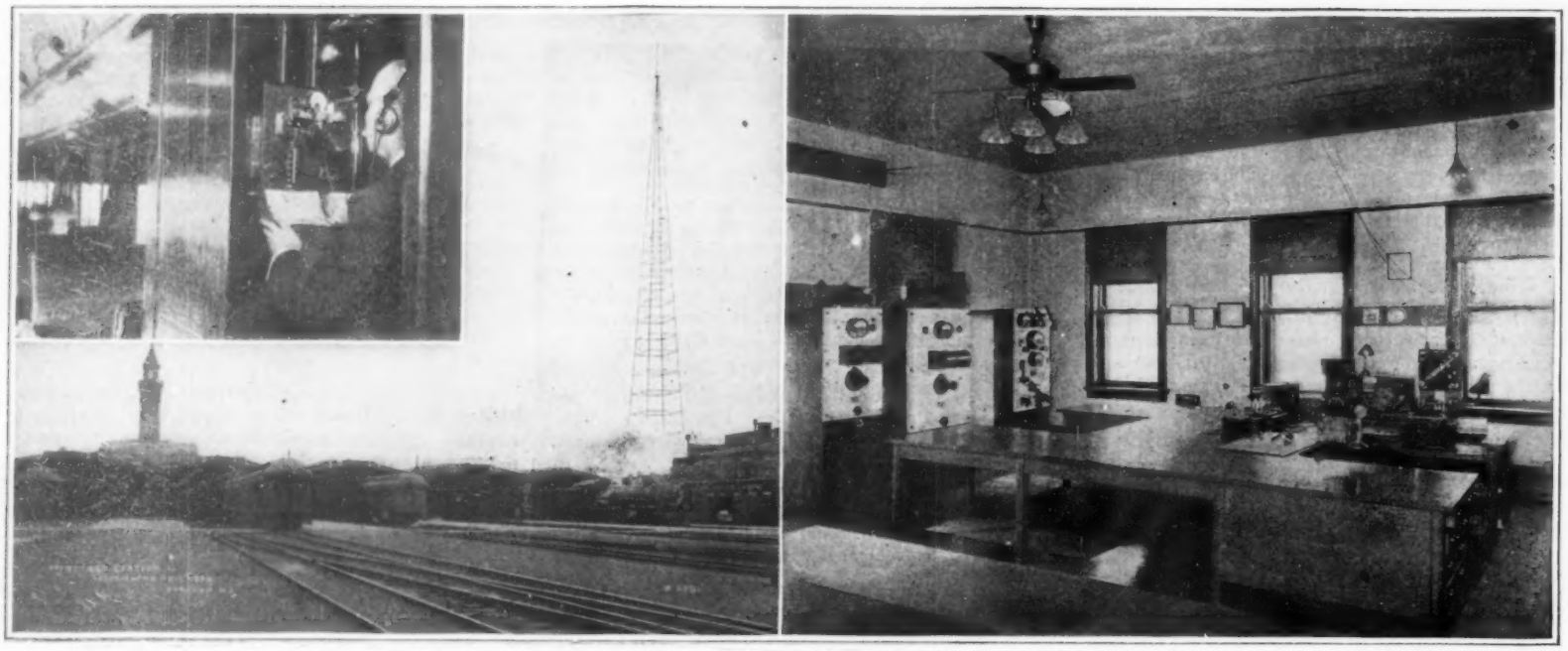
Shale Oil Economics.—A somewhat new angle on the possibility of commercial success in the handling of the shale oils of the Far West is afforded by a contemporary discussion of the feasibility of obtaining nitrogen as one of the products of shale distillation. It is suggested that recovery of nitrogen has been effected on a more or less casual basis already, and that if a serious effort were to be made in this direction it would probably meet with success.

A Curious Result of the War.—In November, 1913, Professor Ripper and Mr. Burley read before the British Association of Mechanical Engineers the first part of a very significant paper on the cutting power of lathe turning-tools, in which results of much value were put forward. The second part was promised at an "early date"; but the war arrived before this date. The interesting result is that, after a lapse of more than six years, the second part of this paper was presented in December last. If this is not a record hiatus it ought to be.

Crude-Oil Chemistry.—A recent investigation shows that, though the general tendency is toward increase of hydrogen content with the lighter oils, there is no exact relationship between the specific gravity and the amount of hydrogen present. Extraordinary as it may seem, it was found possible for oils with substantially the same percentage of inert matter to vary both in hydrogen and in carbon content, with practically no variation in heating value. From this, *Power* concludes that the calorific value of crude oil does not correspond to the heat of combustion of its elemental constituent.

Standard Specifications for Gas Hose have been worked out by the Bureau of Standards, and the results published in Technologic Paper No. 133 of the Bureau. It was found that some of the old specifications were too light, and others too severe. Among those newly adopted are: crushing resistance of 100 pounds per lineal inch; longitudinal tensile strength of 75 pounds; ability to twist 180 degrees per 2 lineal feet without damage; ability to bend into a circle of 6-inch diameter at freezing temperature; freedom from softening after 24 hours at 125 degrees Fahrenheit, moist heat; and maximum leakage of .02 cubic feet per 6 linear feet per hour after any of these tests.

Salvaging Worn or Damaged Machinery.—The scarcity of machines and material during the war introduced many novel practices of economy, says *The Engineer*. Not only has welding attained a vogue never before approached, but efforts have been made to repair worn parts by electro-deposition. Experiments have recently been carried out looking to the application of this idea to the salvaging of small steel parts that have been machined to too small sizes. The electrolyte used was an aqueous solution of ferrous ammonium sulfate; the best results were got from a solution made about .005 Normal with respect to sulfuric acid. The experiments show that iron can be laid down directly on steel, and the deposit case-hardened.



Left: Lackawanna Railroad terminal at Hoboken, N. J., showing the tall wireless mast. *Right:* Receiving room of a wireless station operated by the United Fruit Company. *Insert:* Wireless telephone booth aboard a Lackawanna train.

Three examples of how radio telegraphy and telephony may be applied to everyday life

Wireless and Everyday Business

How the Recent Development of Radio Communication Makes It Practical for Scattered Organizations

By Benjamin F. Miessner

PROBABLY the most potent single force acting on the peoples of the world in enlightening and civilizing them, in hurrying their progress, in drawing them nearer one another and linking them together in a hundred varying ways, is no longer, as of old, the sword, nor is it the pen; it is no longer the printing press, the steamship, or the railroad; it is neither art, nor music, nor medicine, nor law, nor agriculture, nor industry, nor commerce, nor yet all of these as a whole, but it is the one which makes them all possible, which aids them all, and which makes them all reciprocally beneficial. This, the greatest of all influences upon the development of mankind everywhere in its broadest sense, is *communication*.

To communication—to telegraphs, to telephones, to cables and to radio, to these modern *means* of communication—the increasingly rapid strides in modern civilization are due, and it is to them, their development and increasing use that we must look forward for still further acceleration of the pace of progress.

Radio, which but twenty-five years ago was only a scientific curiosity, with no immediate practical utility, is today one of the most important of all the means of communication, and it bids fair to become *the* most important of them all. The trend of development points strongly in that direction.

While radio in the past has played a truly marvelous part on the seas in guarding the lives and property of those who traverse them, it is now very rapidly becoming a no less valuable aid in the transmission overland of important information. Widespread commercial organizations which have been required by circumstance to depend on wire systems or special privately owned or leased lines for the transmission of large volumes of important information, are beginning to see the tremendous advantage of privately owned radio systems as an economical and exceedingly satisfactory substitute for the often poor and too often costly services of commercial telegraph and telephone agencies. This has been realized first by the various governmental departments, such as the Army, Navy, Treasury and Postoffice Departments, and by Steamship Companies, and latterly, by some of the larger and more progressive commercial organizations; and it is to these that the advantages of such privately owned and operated radio systems are becoming more and more apparent.

Today where many great industrial organizations consist of large and scattered units separated by hundreds or thousands of miles, the value of immediate reports or of answers to questions within a few moments' time is beyond calculation. As contrasted with the commercial agencies, which usually require hours, oftentimes many wasteful hours, and sometimes a day or more for a reply to a telegram, the private radio system presents great advantages in speed. Subject to no message traffic precedence, no external labor troubles, no wire difficulties in storms, or a dozen other contributing factors to slow or undependable service, the private radio system is greatly to be desired; it is at all times instantly available for routine or especially important message traffic.

Radio is past the experimental stage of uncertainty and unreliability; it is past the stage of stock swindling and extravagant claims. It has been reduced to an exact engineering science and principles of design are applied just as accurately in constructing a radio station to transmit so many miles, as in the building of a bridge to sustain a load of so many tons. Systems can now be designed for communication at ten or ten thousand miles, and they can be depended upon.

Difficulties due to interference and to atmospheric disturbances are also being rapidly overcome, either by sheer brute force of overwhelming power, or by ingenious schemes and inventions designed to circumvent them. Among the latter the directional receiver is probably the most notable and efficient. It not only enables a mariner or an aviator to determine his position with reference to other radio stations, but it also enables one to single out any one of a dozen different stations, to choose the direction from which received signals must come to be effective, and it permits operation under conditions where the ordinary aerial receiving systems would produce only an unrecognizable babble of conflicting signals.

These conditions of interference in some localities, such as great seaports where many land and ship stations are constantly in operation, are still quite serious enough to warrant the present governmental control and restriction, but throughout the vast interior regions where the ether is comparatively free of radio waves too powerful to evade, the field for private enterprise in erecting and operating radio systems is as free and open as the vast areas themselves.

A few examples typifying the varying kinds of industry successfully served by private radio systems during the past will indicate even to the most casual observer that the limitations of radio in industry are few and far between.

Take the case of the United Fruit Company. There is an organization partly agricultural, partly maritime and yet partly commercial. It represents an investment of about seventy-five million dollars. Immense fruit-growing regions are owned or controlled by it in South America and the West Indies—it owns and operates twenty-five steamships for transporting its fruit; it sells the fruit in the United States.

For ten years this great organization has owned and operated its own system of communication. It owns about seven high-power stations in the United States and South America, and each of its twenty-five ships is equipped with radio. The system is not merely desirable or valuable, it is absolutely indispensable to the successful conduct of the routine work of this large company; because of the highly perishable nature of the fruit it deals in, such for instance as bananas, the regulation and direction of the fleet of vessels and daily reports as to the conditions of the fruit itself before and after shipping are of the utmost importance.

Consider for a moment another example, this time in the field of transportation. Some years ago the Lackawana Railroad undertook on a rather extensive scale, some experiments with radio in train dispatching. Stations were erected at Hoboken, Binghamton, Scranton and Buffalo along the main line of this road. The system was intended not as a replacement for their existing wire lines, but as a reserve in case of emergency. Although the results secured in actual service were favorable in comparison with wire service, the true worth of the system was not realized until a terrific storm in 1914 completely demolished every wire system in the East for nearly two weeks. The Superintendent of Telegraph of the Lackawanna system recently stated to the writer that this one service rendered by

(Continued on page 198)

WHY not employ a private wireless system instead of a privately-owned or a rented telephone or telegraph line? At first the suggestion appears rather ambitious—ambitious just because the average business man has but a hazy idea of the recent progress made in radio communication. Mr. Miessner, a radio engineer of standing, has undertaken to point out how radio can be employed in everyday private business, and how some concerns have blazed the way along these lines.—THE EDITOR.

Drainage canal which takes the water away from a large flooded area

Typical dredge of the sort used in drainage work

Reclaiming the No-Man's-Land of America

By Bennie Hall

WHILE the high and mighty argue whether the eighty-five million acres of swamp land in the United States shall be reclaimed by public or private enterprise, hundreds of powerful dredging machines are ploughing their way through the low-lands of the South and Middle West, converting a region that for many years has borne the reputation "Fifty bushels of frogs to the acre, and enough snakes to fence the land" into a land that will produce from 60 to 75 bushels of corn to the acre.

According to statistics recently given out by the Department of Agriculture, more than seven million acres have been drained, and drainage districts have been established in every state having land subject to continual or periodical overflow.

The increasing demand for land adds continually to the incentive for reclamation, while improvements in methods of moving earth and of clearing land tend to reduce the cost. Many projects which a few years ago were too expensive to be undertaken are now being profitably developed.

What is said to be the most extensive drainage project ever undertaken in the United States is located in southeastern Missouri and the northern part of Arkansas, and is now nearing completion, adding more than 500,000 acres (about 800 square miles) to the available farming lands of America. Work in this district, covering a period of more than ten years, involved the digging of more than 600 miles of interior arterial ditches, and called for an expenditure of four million dollars for the trench digging operations alone. The completion of this project not only adds to our national wealth but marks the victory of engineering skill over the waste laid by the great earthquake which 108 years ago converted hills into lakes and changed the topography of three states over night.

In this district, land that sold for a dollar an acre less than twenty years ago is selling for $150 to $200 an acre; land that two years ago stood under a sickly green slime is today producing abundant crops of corn, wheat and other products.

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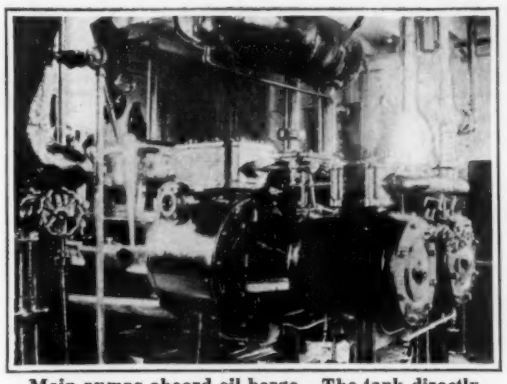
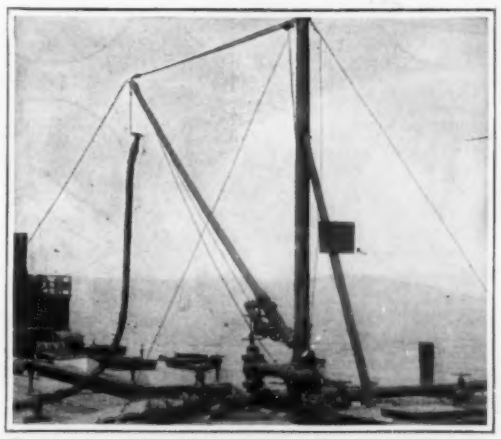


Main pumps aboard oil barge. The tank directly above the pump carries off the exhaust steam to heat the feed water



Tackle aboard the oil barges whereby one man handles the hose and nozzle

San Francisco as a Fuel Oil Port

By C. W. Gieger

ACCORDING to figures given out by the Bureau of Customs, the port of San Francisco for the first nine calendar months of the year 1919 bunkered ships with fuel oil to the extent of 1,459,802 barrels of 42 gallons each.

One of the unique features at San Francisco is the "Day and Night service." The companies that provide this service maintain certain oil carriers manned by both day and night crews, and are ready to make fuel oil deliveries around the harbor at any time during the entire twenty-four hours.

The oil barges shown in our photographs have a capacity of about 5,500 barrels of oil. The oil pump is operated by a 50-horse-power gasoline engine. The pump has a suction of 8 inches and a discharge pipe of 6 inches in diameter. They are capable of delivering oil into the ship's tanks at the rate of over 1,000 barrels an hour. The barges are loaded at Richmond, a distance of about 15 miles from the San Francisco water front.

Excellent living accommodations are provided aboard the barges. The chief engineer and two deck hands operate the barge for a 24-hour shift, and the captain and two fresh deckhands take the following shift.

These barges are towed by a powerful steam tugboat, which also furnishes live steam for the purpose of cleaning out the oil tanks. Special pipes extending along the deck and into each oil tank are provided, and by means of these, live steam from the steam tug is introduced into the oil tanks. Live steam is held in the tanks for about 12 hours, after which the sides and bottom of the tanks are "hosed down" with hot water. After the water is pumped out members of the crew enter the tanks and shovel out all solids and other material washed from the inside of the tanks. The interiors of the tanks are then wiped dry. This process is carried out at stated intervals, and is always done when a different kind of oil is to be carried, this being necessary to guard against contamination.

A number of unusual features are provided on the barges of the sort shown in our second picture.

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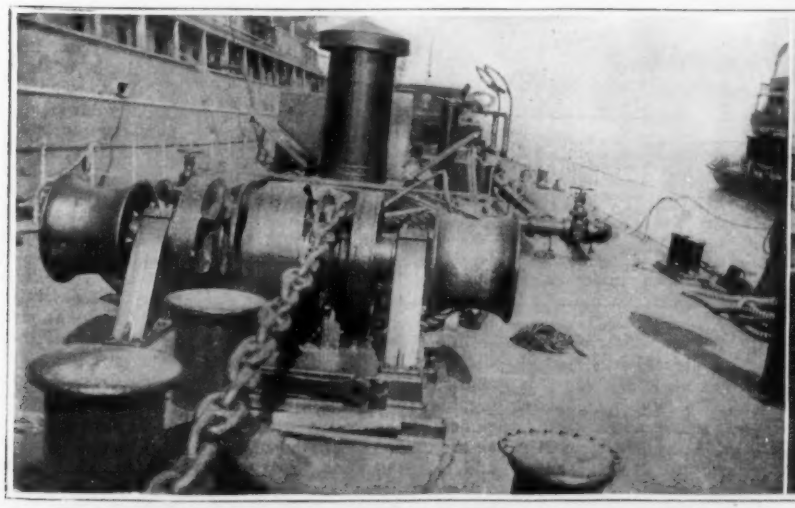
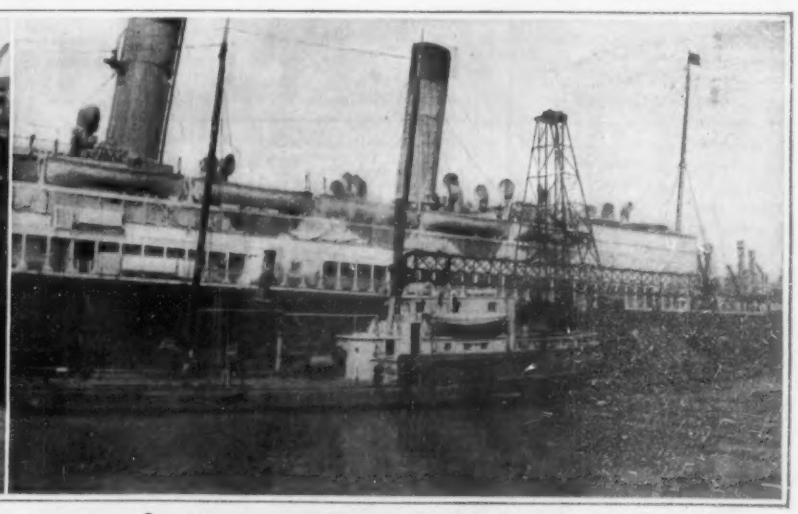


Barge delivering oil to a steamer plying between San Francisco and the West Coast of South America



Japanese steamer taking on oil and coal, either of which she is equipped to burn

Hairs that Make Fabrics

The Microscopic Identification of Mammal Hairs Used in the Textile Industry

By Leon Augustus Hausman, Ph.D.

THE textile industry is of great antiquity, and as the art of weaving preceded that of spinning, so the art of felting antedated both. Hence felted fabrics represent man's earliest attempts at textile fabrication. The inhabitants of the middle and northern regions of Asia apparently employed felts of various sorts from a period of very remote antiquity as articles of clothing, or in the construction of their habitations. Most of the writers of classic times refer to felt more often than to woven products, and some describe the process of its manufacture. Among many of the ancient peoples heavily constructed textiles, predominantly felts, were used for the manufacture of hats, outer garments to shed the rain and snow, and often as a species of armor.

The fibers utilized in felting were largely those of animal origin, *e. g.* hair and wool, but with the advent of the arts of weaving and spinning, vegetable fibres came into use, and have since increased in importance as textile fibres. However animal hairs still hold the place of prime importance in the textile industry, not only in felting, but in spinning and weaving as well. Following these, in the descending order of their importance, come the fibres of vegetable nfacture, and of mineral origin, of artificial manderivation.

Up to the present time no systematic series of zoologically sound criteria for the indubitable identification of mammal hairs was to be had. In a recent contribution to the knowledge of the structure of mammalian hair (*A Micrological Investigation of the Definitive Hair Structure of the Mammalia, with Especial Reference to the Monotremata*, in press) the present author has pointed out that certain constant characteristics of the microscopic elements in the structure of the hair shaft are of importance from several zoological viewpoints. That the results of the application of these determinative criteria may be of practical value in the more rapid and certain identification of the various mammal hairs used in the textile industry, it is the object of this paper to suggest. With the present-day extraordinary increase in the number of the different kinds of fibres used as bases for textile fabrics, methods for the indubitable identification of fabric stuffs would seem to be of no small utility. Of the various classes of fibres used in textiles; artificial, vegetable, mineral, and animal, those of the latter class have given the most difficulty in accurate determination..

In order to appreciate the nature of the structural elements of the hair shaft which are made use of in identification, it will be necessary to pass briefly in review the structure of the typical mammalian hair. Hairs take their origin from the bases of relatively deep pits in the epidermis, or outermost layer of the skin, known as hair follicles, and, being added to from the base, push upward in a rod-like growth, of circular or elliptical cross section. The hair shaft consists of four structural units: (1) the *medulla* (M, Fig. 23), often commonly termed the pith from its analogous structure in plant stems, which is built up of many superimposed cells or chambers, and containing air spaces and sometimes small masses of pigment material; (2) the *cortex* (CO, Fig. 23), or shell, surrounding the medulla, and composed of many elongate, fusiform cells, coalesced together into a horny homogeneous mass, of hyaline texture and appearance; (3) the *pigment granules* (P, Fig. 23), to which the color of the hair is primarily due, scattered about within the corticular substance; and (4) the *cuticle* (CU, Fig. 23), or outermost integument of the hair shaft, lying upon the cortex, and composed of imbricated scales. It is the forms, anatomical relationships, and exact measurements of these four elements, together with the measurement of the hair shaft itself, in micra (1 micron = one one-thousandth of a millimeter, or about one quarter-millionth of an inch) which constitute the series of determinative criteria to which reference has been made.

Medullas fall into four great groups: (1) the *discontinuous* as in the hair of the domestic cat (Fig. 15); (2) the *continuous*, as in the hair of the cow (Fig. 9); (3) the *interrupted*, a type intermediate between the first two, as in the hair of horse (Fig. 10); and (4), the *fragmental*, as in the hair of the vicuna (Fig. 8). It will be noted that the hair of some species apparently lacks the medulla altogether, though minute dissociated traces exist in certain portions of the hair shaft.

The cortex element, as has been said, is of homogeneous, hyaline texture, and only under special complex treatments can be made to exhibit any structural characters. Hence, when used in description it is merely measured, as to thickness, between the medulla and the cuticle.

The pigment granules, when present in sufficient quantity, are of characteristic form, color, depth, and disposition within the cortex, and can be used as dependable coördinate criteria. (Figs. 20, 21, and 22.)

That structure which presents the most readily usable, though not necessarily the most dependable characteristics, is the cuticle, whose component elements, the scales, are of two diverse types: (1) the *imbricated interrupted* type, those which lie singly overlapping upon the hair shaft, like the shingles on a roof, or the scales on a fish (CU S, Fig. 23), as in the hair of the badger (Fig. 16); and (2) the *imbricated coronal* type, those which encircle the hair shaft as continuous bands, building up the cuticle somewhat like a pile of tall tumblers set one within the other, as in the hair of the intermediate bat (Fig. 19). Of these two primal types there are a multitude of intricate variations. The pelage of a very large number of mammals consists of two kinds of hair; a soft, dense, short, fine hair, called the under or fur-hair, and a longer, coarser, stiffer, sparser growth, which projects beyond and overlies the fur hair, termed the over or protective hair. Examination of both of these types of hair is sometimes necessary, though ordinarily the shafts of the fur hair alone furnish sufficient, conclusive identification data. In felting, particularly, both kinds of hair are usually included in the fabric, when the hair of such mammals as the cat, or of the different species of beaver, rabbits and hares, is used.

Heretofore the methods of preparation and examination of hair shafts have been too crude to afford exact

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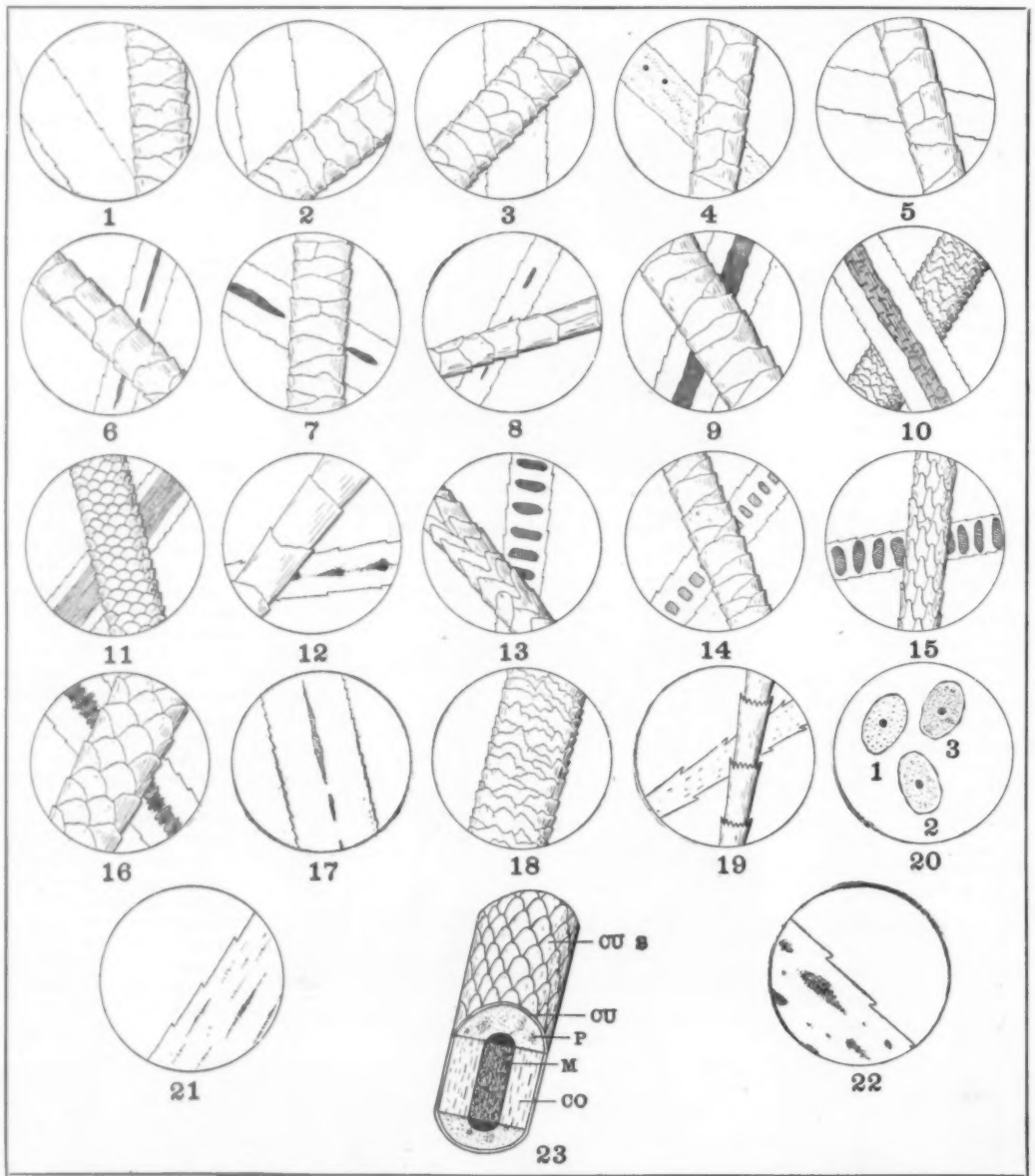

(1) American Southdown sheep—40μ; (2) American Shropshire sheep—30μ; (3) Dorset sheep—33μ; (4) Angora goat, source of mohair—20μ; (5) Bactrian camel—19μ; (6) Guanaco—18μ; (7) Alpaca—28μ; (8) Vicuna—11μ; (9) Cow—47μ; (10) Horse—130μ; (11) Virginia deer—103μ; (12) American beaver—18μ; (13) Hare—17μ; (14) American gray squirrel—18μ; (15) Domestic cat—16μ; (16) Badger—48μ; (17) Man—medulla of Caucasian female—50μ; (18) Man—cuticular scales of Caucasian female—50μ; (19) Intermediate bat—17μ. Figure 20 shows transverse sections through human hair-shafts, displaying contour of medulla and disposition of pigment granules: (1) blonde Norwegian female, (2) brunette American, (3) black Indian male. Figure 21 shows portion of hair shaft from brunette American, highly magnified, to show characteristic appearance of pigment granules in their method of massing. Figure 22 shows portion of fur hair-shaft from cat, with the same object. Figure 23 represents an ideal mammalian hair-shaft; see text for reference letters. In Figs. 1-19 the upper hair shows the cuticular scales, the lower the medulla

The more important mammal hairs, with sizes in micra; and some general structural characteristics

The Scientific Reason for Failure

Why Habit Is Often the Cause of Discouragement

By D. H. Colcord

ONE often hears, it is said, that the cause of failure or success lies within one's self. To observe the scientific activity of the human mind often reveals laws of nervous action that are exceedingly helpful in our daily lives. It is well to understand how and why one always acts in a certain manner under the same conditions. Often times you will be surprised to find that there are certain things that you do, the reasons for which are so deeply embedded in the nervous system that you have little control over them. Did you ever study the reasons why you are apt to make mistakes to a greater extent after you have learned a new act than at the beginning? Thousands of men and women every year get discouraged on a new job and quit, whereas, if they understood the nervous adjustment that was taking place in their new environment, they would understand their fits of blues and "stick" until they had found their new work easy and pleasant.

I knew a young man that applied for a position as a press-feeder in a large publishing house. He had had no experience, but stated that he was very anxious to learn the trade as he understood it was very pleasant, easy work, and the hours were short and the remuneration always good. He was very ambitious and looked like good "timber" for the press room. In three weeks he came to the office and wanted to quit. He said that he was not cut out for a press-feeder, and that he was thoroughly discouraged. I was surprised, as I had noted his progress during the first two weeks and he seemed to be getting along in splendid fashion. He admitted that everything was easy to learn at first, but on the third week it seemed impossible for him to feed the paper into the presses without spoiling it. He said that he got so nervous that it was impossible for him to keep his head in any sort of an emergency. He quit, and I never have heard from him since. His case is typical of thousands in every line of industry. A certain nervous and mental readjustment was taking place during the third week, which he did not understand and over which he had no control. The following is what actually happened to his nervous system:

Running from the brain down the spinal cord and out to the limbs and body are millions of tiny nerves. They carry messages from the eyes, ears, nose, tongue, muscles and skin to the brain. Thus we get our impressions of the outside world. When the message gets to the brain it is interpreted. That is, we recognize a sensation that comes in the form of black blurr, as a "shoe" or a "hat" or whatever we happen to sense. The brain sends back messages to the muscles through another set of motor nerves—messages to act in a certain way. When the same message goes to the brain over and over again and the same action results, the nervous tissue that carries these messages becomes susceptible to that particular message and its corresponding reaction. When this happens, we have formed a habit.

As a matter of fact, our lives are so ordered that about ninety-five per cent of all our sensations and actions are the same day after day and are habits. It is a fact that man is a creature of habit.

Put a man in a new environment and all of his old habits are broken up and he must learn new ones. The change is stimulating at first—it acts upon us as does a vacation among new faces. The boy spoken of above found the new work at the presses interesting at first and he succeeded in doing well what he attempted to do because he was attending to every action. He was not depending on habit. Very few of his old habits would serve him here.

At the end of the second week the novelty of the new job began to wear off and he began to feel that the motions he went through to put the paper in the press had become habits. He thought he had the job learned. In his old environment he did a lot of the mechanical tasks without attending to them and had no trouble. On the third week, he relaxed his attention and tried to let habit do the work. Habit failed to act for him because it was not thoroughly formed. If he had held his attention to the work at hand one more week, it would have been fixed and the new adjustment would have been made. When he relaxed, things began to go wrong—he spoiled paper and could do nothing right.

If the reader wants to see just how the nervous system is affected by a change of environment let him deliberately form some new habit and observe its growth. He will find that there is a "dangerous" period, when he thinks that the habit is formed, and it is during this period that mistakes and discouragement come.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Who Invented the Vacuum Tube?

Mr. Pierre H. Boucheron:

I have read your article entitled "Vacuum Tube," published in the SCIENTIFIC AMERICAN of January 17, 1920.

The second paragraph under the caption "Historical" leads me to infer that you are not acquainted with the paper read by Professor Edwin J. Houston, before the American Institute of Electrical Engineers at Philadelphia, in October, 1884. This paper was devoted to the peculiar high vacuum phenomena which I had observed sometime previously, and which became known as the "Edison Effect." If you will look up Professor Houston's paper and read it, you will see that it should have been called the Edison valve. This term, however, came into use later on.

In the above-named paragraph you attribute to Dr. Fleming the discovery which I had previously made. Do you not think that I am justly entitled to a correction to the effect that it was *not* Fleming who discovered the valve? As a matter of fact, Dr. Fleming's principal distinction in connection with this discovery is that he was the first one to apply it in radio telegraphy. THOS. A. EDISON.

Orange, N. J.

To the Editor of the SCIENTIFIC AMERICAN:

I am sending you the above letter from Mr. Thos. A. Edison, calling my attention to a certain paragraph of my article, "The Vacuum Tube," which appeared in the SCIENTIFIC AMERICAN for January 17, 1920.

In the paragraph referred to, I wrote that Dr. Fleming was probably the first scientist to *make use* of the "Edison Effect." I am familiar with the fact that this use was new in the sense that it was employed for the first time as a detector of radio telegraph signals. In other words, Dr. Fleming found a *new use* for an *old device*.

I had previously read Professor Houston's paper which speaks of Mr. Edison's original observation. This observation referred to patent No. 307031, issued him on October 21, 1884, for an "Electrical Indicator." The patent comprised an evacuated bulb containing a hot filament and a cold cathode or plate with a current flowing between these two elements; in fact, an arrangement practically the same as that of Dr. Fleming's later patent dated November 7, 1905.

Of recent years, there has been considerable controversy as to the rightful inventor of the present-day vacuum tube. In the suit of Marconi vs. De Forest, Judge Mayer, among other things, said, "Stripped of technical phraseology, what Fleming did was to take the well-known hot-and-cold-electrode incandescent electric lamp of Edison and use it for a detector of radio signals."

In my article I should perhaps have qualified my statement a little more specifically in writing of Mr. Edison's original discovery. Once for all, let us have it right; the present-day vacuum tube may be attributed to the individual fundamental researches of the following scientists:

Edison for the above-mentioned device producing the effect which bears his name.

Fleming for applying Edison's device for the *first time* to radio telegraphy.

De Forest for the addition of the third element or "grid" to Fleming's application of the device, thereby rendering it more effective in its manifold uses.

Your courtesy will be greatly appreciated if you will kindly publish this explanation in an early issue of your valuable paper. PIERRE H. BOUCHERON.

Brooklyn, N. Y.

Legal Advice With A Guarantee

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the article under the above title in the number of the 16th of August, allow me to draw your attention to the practice of law in Ontario. Under our rules we have a number of cases such as questions between vendors and purchasers, some questions of title, the construction of wills and advice to executors, etc., in which the opinion of the Court can be had without commencing a law suit. The procedure is what we call under *originating notice*. Among these rules is one reading as follows:

Where the rights of the parties depend (a) upon the construction of any contract or agreement and there are no material facts in dispute, or (b) upon undisputed facts and the proper inference from such facts; such rights may be determined upon originating notice.

It is also provided that a contract or agreement may be construed before there has been a breach thereof. Would not this practice cover the point raised by your article?

JAS. R. ROAF.

Toronto.

The Helicopter

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 17th, a letter by the writer was published stating the views of Dr. Hewitt and myself with regard to Helicopter No. 1 which we designed, built and tested and with it have demonstrated the practicability of this type of aircraft. In the headline editorially printed above my letter, our machine was through some inadvertence called "The Crocker-Cooper Helicopter."

Dr. Peter Cooper Hewitt bears very honorable names to which he is directly and justly entitled, in fact he, himself, has added much to their lustre. Dr. Hewitt being a distinguished scientific American merits such consideration and care from the SCIENTIFIC AMERICAN that the mistake of taking liberties with his name should not be made even accidentally.

Moreover his name should appear first because he has contributed more than the writer to our success. On the other hand the writer has done his best and also contributed in many ways to the solution of the problem and to the conclusive results that we have obtained. FRANCIS B. CROCKER.

Another Version of the Flexible Saw

To the Editor of the SCIENTIFIC AMERICAN:

A copy of your interesting and useful paper dated August 2, has come into my hands. I notice on page 116 a photo of a flexible saw taken by a doughboy from a Fritz during the recent "rough house."

I recognize this saw as being part of the equipment of a field company of British Royal Engineers. I served in this branch of the army as a sergeant throughout the war. Landed in France in October, 1915, sent home, crocked in August, 1917, and employed as instructor until April, 1919. This saw was supplied in a leather case and would be used by passing a couple of sticks or entrenching tool taps through the rings at the ends. It is very handy for transport as it rolls into a small compass. I think that the Bosche that lost it had previously "souvenired" it from some of our chaps. If captured after the big drive in March, 1918, it was probably part of the material captured in dumps, etc., at this time.

My object in writing this is to correct the tendency to give the Boche credit for the devising of this very handy tool. It is a British tool and part of the equipment of that little British army that goes a damned long way.

Good luck to the Yank that got it and I only hope that the Boche from whom he got it was a "good" one and had no further use for it or any thing else in this world. H. W. STOWERS.

Belfast, Ireland.

Speaking of Tall Chimneys

Some of the World's Leaders, and the Reasons Why They Are Built So High

By J. F. Springer

WHERE is the tallest stack in the world? And is it the biggest? Well, to begin with, the big stack at Great Falls, Mont., is a pretty tall fellow, reaching as it does 506 feet above the ground. Then Japan has a taller stack than this in the great smelter plant at Saganoseki; its top rises to a height of 570 feet. Finally, the publication in America of details, coupled with a claim for the record, brought forth a protest from Tacoma, Washington, where another smelting plant has a stack whose height is 572 feet 10 inches.

If any of these structures was upon completion the tallest in the world, however, it held the record only a short term. The recently finished smelter chimney at Anaconda, Mont., is now claimed as the tallest and also as the biggest chimney of the entire world. Its height is 585 feet 1½ inches. The inside diameter at the top is 60 feet; so that it delivers to the general atmosphere a mighty stream of stack gas.

The company had an older chimney having a height of 300 feet with an inside diameter at the top of 30 feet. The layman might think it reasonable to suppose that this stack would be equal to all possible demands. But such was not the case. It was proposed to install an electric system for the treatment of metallurgical smoke with a view to the recovery of valuable metallic material. The old stack was deemed inadequate and the new one built. Naturally, such a structure, when to it are added the remaining reclamation works, means a big outlay of money.

One would hardly suppose it worth while to make such an effort for the mere recovery of waste metal dissipated into the air along with the natural smoke. It has, however, been estimated that a big stack in the mining region of Arizona belches forth daily enough copper in the form of débris carried by the stack gasses to amount to a total of anywhere from 3 to 9 tons per day. Take the average and allow 300 days to the year. The annual loss would then total 1,800 tons of copper. This is, doubtless, an extreme case. But there are probably quite a number of stacks engaged, on a large scale, in dissipating valuable metal, especially copper, into the atmosphere.

It is one of the aims of modern progress that all waste should be avoided in so far as it is possible to avoid it. Sometimes, it would cost more to effect recovery than the material is worth. A million dollar investment in a recovery works means a fixed charge, to begin with, of something like $50,000 to pay the interest on the first cost. This is quite apart from the cost of operation, upkeep, etc. So, after all, it will sometimes happen that a big waste is inevitable. However, as this concern at Anaconda is going into the business of reclamation, one presumes that it sees a balance on the right side of the ledger.

The purpose of this chimney is to create a draft in and effect a disposal of the smelter gases, and thus perform its part in the reclamation from the metallurgical smoke of gold, silver, copper and arsenic which would otherwise be wasted. The fumes carrying these materials are produced by the converters, roasters and reverberatories. It is expected to recover some 32 tons of arsenic per day of operation.

The stack may conveniently be divided into two parts: the base, rising 30 feet above the ground, and the stack proper. The base reaches down, on one side, to a somewhat lower depth than elsewhere. Here the base-height is 33 feet. In the base are some 5,000 cubic yards of concrete. The form is that of a low octagonal tower. From angle to angle, the octagon measures, on the outside, 96 feet. In the stack portion there are between 2,000,000 and 3,000,000 special bricks. Each of these is, on an average, equivalent to 3 bricks of the common kind. These special bricks were made from the tailings from the smelting works. The lowermost 68 feet of the stack above the base is also octagonal. The remainder is circular.

I do not know whether any tests have been carried out on any of the giant stacks in the United States with the view of determining the behavior of the structure when subjected to the unbalanced pressure exerted by heavy winds. In Japan, where high winds are appreciable and earthquakes are common, the matter has been investigated with a great degree of thoroughness.

The Saganoseki stack of concrete, as already stated, is 570 feet tall. The foundation is a mass of concrete having a thickness of 17 feet and a diameter of 95 feet. The weight has been estimated at 4,714 tons. The main shaft tapers from 32 feet 8 inches at the base to 27 feet 5 inches at the top. This shaft is estimated to weigh 4,852 tons. The total weight of the whole affair may be divided into 9,139 tons of concrete and 427 tons of steel reinforcement or the like. The center of gravity is at a level above the ground of about two-fifths the total height. This structure was tested for vibration. Upon the first day, the wind had a velocity of 54 miles per hour. The top of the stack oscillated through a distance of about 1 inch. Each oscillation occupied 2¼ seconds. On the final day, the wind had

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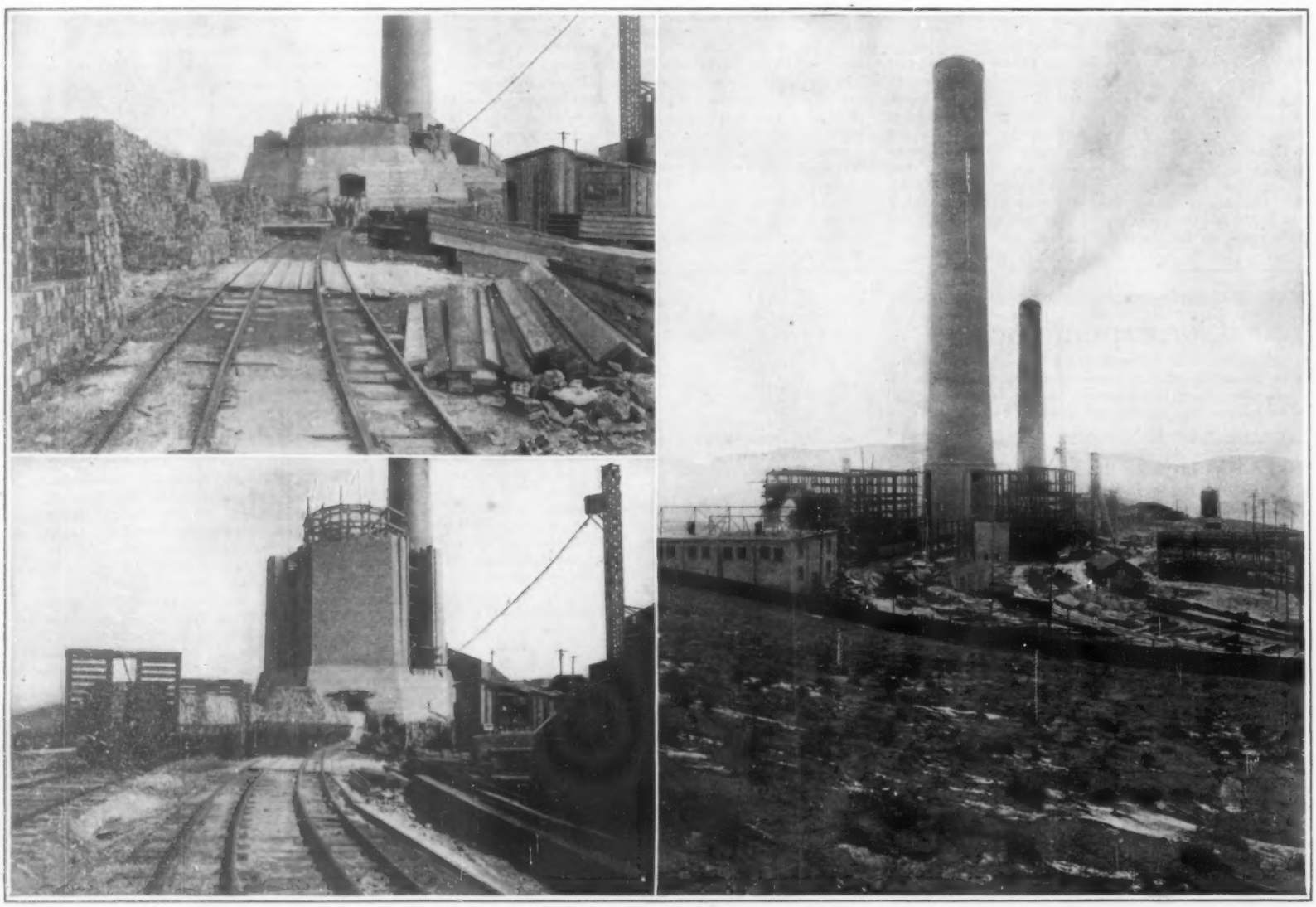
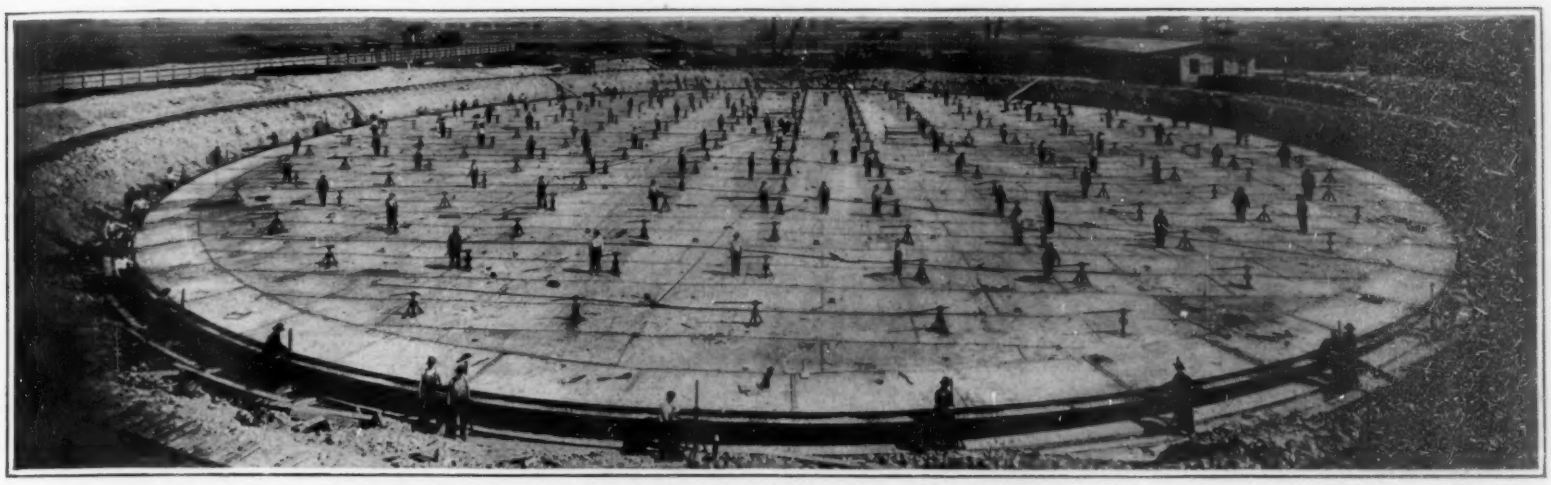


Two views taken during the construction of Montana's claimant for chimney honors, and one of the completed stack



Lowering into place the steel tank-bottom for the ten-million-cubic-foot gas tank in Chicago

The Modern Gas Holder

By Charles W. Person

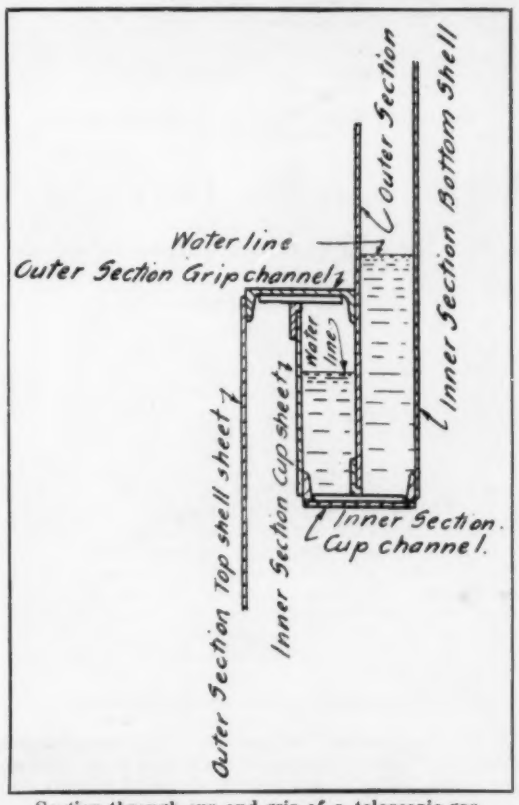
THE other day a steel gas holder with a capacity of 10,000,000 cubic feet of gas was put in service in Chicago. It is one of the four largest steel gas holders in the world and illustrates in a striking manner the great progress that has been made in this specialized field of structural engineering.

The Rev. Dr. John Clayton, of England, is credited with being the inventor of the gas holder. In 1860 he collected a substance called the "Spirit of Coal" in bladders, from which the air had been expelled, and the gas was afterwards burned from the bladders in which it was collected. This was the advent of the first "gas" and the first "gas holder."

Many years later, after gas actually had been made for distribution, Sir Humphrey Davy considered lighting a town with it such a visionary scheme that he asked if it were intended to use the dome of St. Paul's for a gas holder; to which Mr. Clegg, the pioneer in gas engineering, replied that he hoped to see the day when gas holders would not be much smaller.

The gas holder recently erected at Chicago contains five times as much gas as could be stored in St. Paul's dome, so Mr. Clegg's hopes have been more than realized. Were he suddenly to come to life today he would be astonished to hear that the gas holder is to the city using artificial gas what the reservoir is to a city's water supply. It would interest him also to know that the gas holder is the most expensive single piece of equipment a gas company is called upon to provide.

The modern gas holder is composed of three distinct parts: the tank, the holder proper, and the guide frame. The tank contains the water necessary to seal off the holder as its bottom circumference, and thus prevents the escape of the gas. The guide frame guides the holder and preserves its equilibrium during its ascent when it is being filled with gas, and also during its descent, when the gas is being removed.



Section through cup and grip of a telescopic gas-holder, when holder is cupped

The earliest types of gas holders were built in the form of cubes and other rectangular surfaces, but these shapes possessed many disadvantages independent of the great waste of material required in the construction of a rectangular figure, as compared with that necessary for a cylindrical vessel of the same capacity. These rectangular shapes also required considerable bracing, and other precautions had to be exercised in order to render the resistance of the structure uniform.

In the earliest days of gas lighting the tanks of the gas holders were made of wood, but the ammoniacal liquor contained in the water, deposited there by condensation from the gas, soon destroyed the wood and made the tanks useless. On the other hand, the constantly increasing consumption of gas required larger storage space than could be afforded by the wooden tanks and other materials had to be used.

In these earlier days, or before the steel mills were capable of turning out steel plates of sufficient size and thickness to meet the requirements of holder tank design, the tanks were built in excavations in the ground, the bottom and walls being made of brickwork, stone or concrete. As a rule, the tanks of all gas holders today are made of steel, Greater New York possessing two steel tank holders each having a capacity of 10,000,000 cubic feet.

The steel tank of a modern gas holder is built above ground on a foundation prepared to receive and carry the heavy load imposed. A tank of this description is shown herewith. It is supplied with two vertical pipes which provide for the admission and egress of the gas, one of them being in communication with the gas producing apparatus, and the other connecting with the distributing mains in the city. The upper edges of the pipes are a few inches above the level of the water in the tank, so that the water cannot overflow into them.

Attached to the shell and top edge of the tank are a series of columns or "standards" which are tied together with horizontal girders and diagonal braces.

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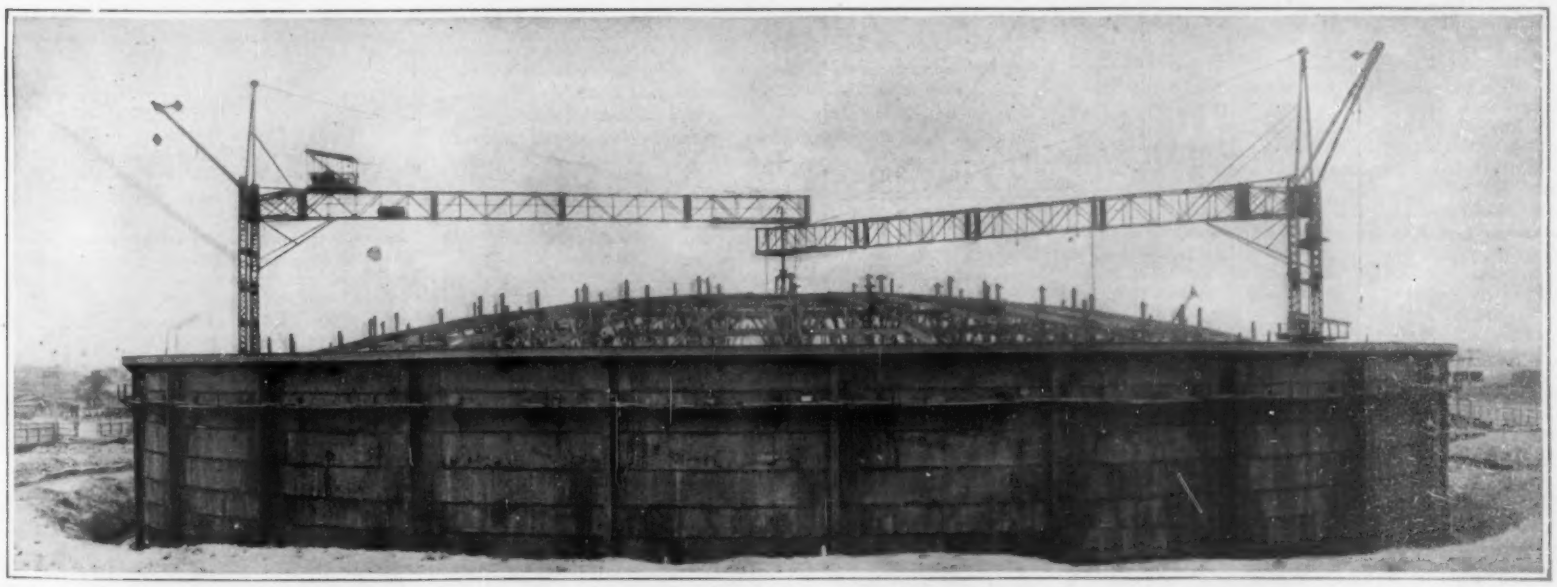
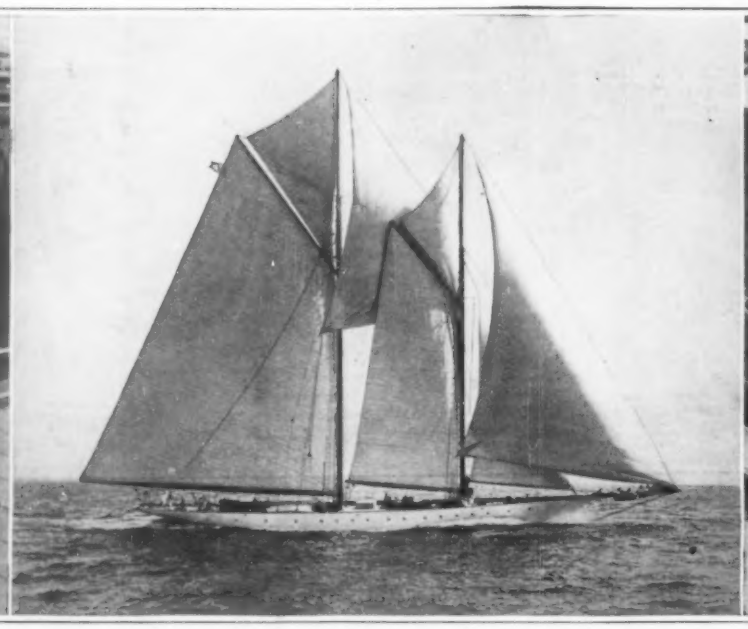


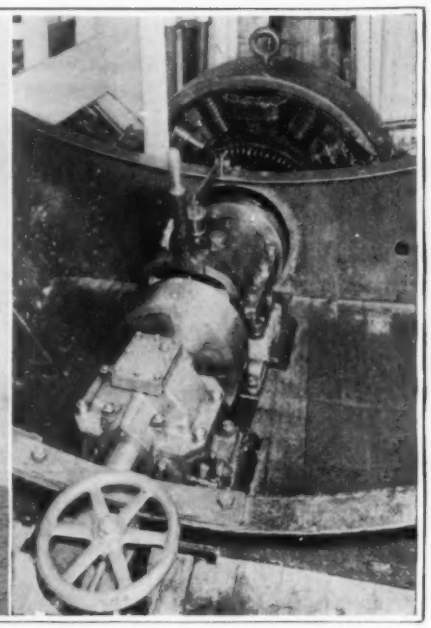
The tank section of Chicago's five-lift gas holder. This holds 16,000,000 gallons of water

Copyright, Edwin Levick

Control handle and meter panel on deck



The yacht "Elfay," which has a gasoline-electric auxiliary plant



The 90-horsepower electric motor and drive

Bringing the Electric Drive to Yachting

A Description of the Diesel-Electric Equipment of the Yacht "Elfay"

MANY engineers believe that the oil-electric drive—in which some form of oil engine drives an electric generator, which in turn furnishes power to motors driving the propellers—will eventually prove the most satisfactory and efficient method of propeling ships having engines of powers up to about 6,000 h.p. Among the chief advantages claimed for this drive are the following:

1. The engine operates continuously at constant speed in one direction only and therefore under ideal conditions. 2. Its fuel economy is exceedingly high. 3. The electric system of distributing and applying power is the most flexible known. 4. The simplest and most effective form of control can be used. 5. Great safety can be secured through the use of several main engines and generators, as well as two or more main motors and propellers, so that part of the equipment can be out of commission without crippling the ship.

A practical application of this drive has been awaited with considerable interest, and in consequence the yacht "Elfay," which went into commission in January, 1920, will probably occupy an important niche in the history of Marine engineering, for she is the first to be equipped with it.

The "Elfay" (formerly the "Katoura") was built by Herreshoff in 1914 for Robert E. Tod. She is a schooner of 152 feet overall, 115-foot water-line, 30-foot beam, and 313 gross tons, and though originally designed as a sailing vessel only, a gasoline auxiliary engine was later on installed in her.

She was bought by Russell A. Alger in 1916 and was but little used during the war. In 1919, Mr. Alger decided to put her into commission again and being desirous of equipping her with a more powerful auxiliary, selected, on the advice of his old friend, Alexander Winton, the oil-electric drive.

THIS is to be a great yachting year; for the representative yachts of the Eastern and Western hemispheres are to fight it out once more over the historic Sandy Hook Course to determine whether the famous America's Cup is to remain, for another year at least, in American custody. We shall hear again the question: Why spend such princely sums on yachts that are good for nothing else but an American cup series? Well, here we present a picture of a magnificent craft, the Herreshoff-built Elfay (formerly Katoura) which, though she is as fast as any American cup-race yacht, can carry her owner and his friends in comfort and safety anywhere throughout the seven seas. Particular interest attaches to the fact that, for auxiliary power, she is provided with the electric drive, which hitherto we have known only as the latest thing in form of drive for the battleships and 33-knot battlecruisers of our navy—THE EDITOR.

Main Engine and Generator

The "Elfay's" main engine is a six-cylinder model 54 Winton full-Diesel oil engine, with a 7½-inch bore, 11-inch stroke, rated at 115 h.p. and running at 425 r.p.m. It is equipped with a very sensitive governor which controls the fuel supply and holds the speed of the engine practically constant, the maximum variation being about 20 r.p.m. A 75-kilowatt Westinghouse direct-current generator of 125 volts is directly connected to this engine; and driven from it by a silent chain is a 9-kilowatt 125-volt exciter of 900 r.p.m., which supplies the field current for both the main generator and the propeller motor and also has about 5 kw. additional capacity for other purposes.

The Propeller Motor

The 42 x 42-inch, 3-bladed propeller is driven by a 90 h.p. Westinghouse motor of 350 per cent p. m., which is placed as far off as possible so that the shaft is very short. A clutch is provided to disconnect the motor when the vessel is under sail. At the maximum motor speed, the speed of the boat is 8½ knots.

Control

The method of controlling the ship is undoubtedly the most interesting feature of the installation. When it is desired to use the power, the engineer starts the engine with its generator and exciter and brings them up to speed. He then closes the switches that connects the propelling-motor armature with the generator, and the propeller-motor field with the exciter. After this he has no further responsibility in handling the ship, except to keep the machinery running properly.

The entire control of the propeller is centered in a handle that is mounted on a pedestal on the deck just forward of the stearing gear. In the center position of this handle the propeller motor is stopped. By turning the handle in one direction, the motor starts, driving the ship ahead with continuously increasing speed, as the handle is turned, until full speed is reached. By turning the handle in the other direction the ship is driven astern in a similar manner. The change from full speed ahead to full speed astern can be made in five seconds. A set of meters is mounted in front of the control handle, which show the voltages of the generator and the exciter, the current being taken by the motor, and the speeds of the generator and the motor.

The navigator, therefore, has complete control of the vessel and can maneuver with the utmost speed and precision, since the motor responds instantly to the controller and there is no delay in transmitting signals to the engine room. At the same time, the meters give him full information as to the operation of the machinery.

The system used is that of the voltage control of the generator. The fields of both the motor and the generator are separately excited, as has already been stated. The motor field is kept always at full strength when the motor is in service, but the strength of the generator field is varied by means of a rheostat which is operated by the control handle. In the off position of this handle the generator field is open so that no current is delivered to the motor. As the handle is moved around, the generator field strength is increased and the voltage of the current supplied to the motor and consequently the motor speed is also increased. When the control handle is reversed, the direction of the generator field current, and also the current to the motor, is reversed, but otherwise the action is the same.

Other Equipment

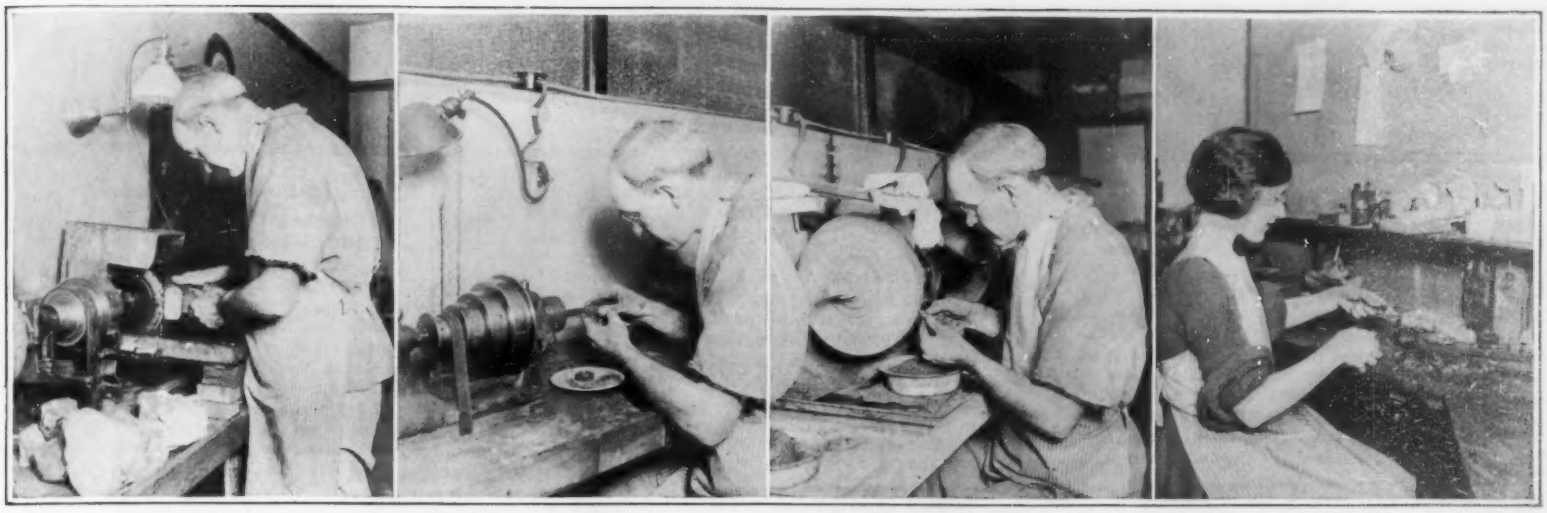
The "Elfay" is lighted and heated by electricity and all of her machinery is electrically operated, including a forward winch for the anchor, two winches amidships for the sails, a 1-ton ice machine, an air compressor, pumps for all purposes, ventilating fans, and electric fans in every room. There is also a ½ kw. wireless outfit.

Performance

It is still too early to judge of the "Elfay's" performance but at present writing her propelling equipment has been thoroughly tested and has proven entirely satisfactory. It is claimed she can make 8½ knots on 7½ gallons of fuel oil per hour, and since she can carry 2,400 gallons of fuel, she is able to run 2,000 miles on her propelling equipment alone, although she will mainly depend upon her sails. She is, of course, by no means a typical merchant vessel, but if the new drive proves successful on her it will unquestionably also be successful on purely commercial ships. Hence there is reason to believe that the "Elfay" represents the dawn of a new era in ship propulsion and that Mr. Alger must receive the credit due to a pioneer.

Icebreakers for Archangel Port

TWO new icebreakers were ordered of a British firm by the late Russian Imperial Government, for duty in Archangel, and one of them was delivered. Owing to the revolution, however, the second was taken over by the British Government. She represents the best development of this sort of vessel.



Cutting the raw agate into slabs | Removing the bored agate from the drill | Shaping the slab to ring form on a grindstone | Mounting the finished rings in metal holders

Four steps in the manufacture of agate guides for fishing rods, as now carried out in America

Agate Guides for Fishing Rods—A New American Industry

By Robert H. Moulton

ONE of the beneficial results of the war was the stimulation of American manufacturers to provide substitutes for countless products which formerly had been imported from other countries, notably Germany. In the majority of cases these home-manufactured products were just as good as the imported products had been, while in not a few instances they excelled them by a wide margin in point of merit and the cheapness and speed with which they could be turned out. One of the latest illustrations of what American enterprise and ingenuity can accomplish has just come to light in the announcement that there has been perfected in Chicago a method of manufacturing agate guides for fishing rods which are not only far superior to those which formerly came from Germany—that being practically the only country to make them before the war—but which can be turned out in a fraction of the time required by the German methods.

Fishing rod guides made of agate have long been considered by expert fishermen to be the best for the purpose: they give a fine appearance to the rod, are practically indestructible, and permit of such a smooth finish that the wear on the fishing line is reduced to a minimum. The Germans were the first to discover these merits of the agate guides and soon had a virtual monopoly of the trade throughout the world. Once having established this, and after creating the belief that good agate guides could not be made in any other country, they grew less particular about the quality of the goods they turned out. As a matter of fact, during the last decade they were unable to keep pace with the demand in this and other coun-

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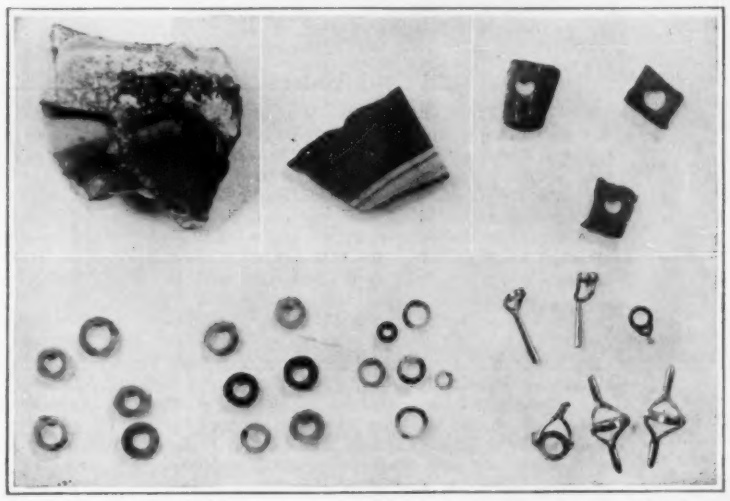

Above, from left to right: piece of raw agate, slab cut from raw stone, slabs with holes drilled. *Below:* Two groups of large and small agate rings in rough form, the finished rings of agate, the mounted guides and tips.

Steps in making the agate guides

The All-Year Carburetor

By Austin Parker

THE vast expansion of the automobile industry, with its consequent drain on the oil reserve of the country, has caused a steady decrease in the quality of gasoline, which, in turn, has faced automobile engineers with the problem of adapting their motors to low-grade fuel. Today, with automobiles supplementing the railroads in hauling the world's freight and passengers, the situation is serious.

Aside from the poor performance of motors when cold, the most noticeable effect of the use of low grade fuel has been in the fouling of the combustion chamber and crank case. Under average driving conditions a small percentage of fuel is deposited in liquid form on the surfaces of the combustion chambers, pistons and spark plugs. If the motor is opened up this deposit of liquid fuel is burned away, but it often reduces to kerosene, passes by the piston and into the crank case where it dilutes the lubricating oil. This condition is found frequently and as a result many engines are prematurely worn out. In the combustion chamber the kerosene not only turns to carbon but it has a tendency to attract free carbon as well. As a result the valves and spark plugs are fouled.

Engineers have agreed that this condition may be overcome only by the proper vaporization of the low-

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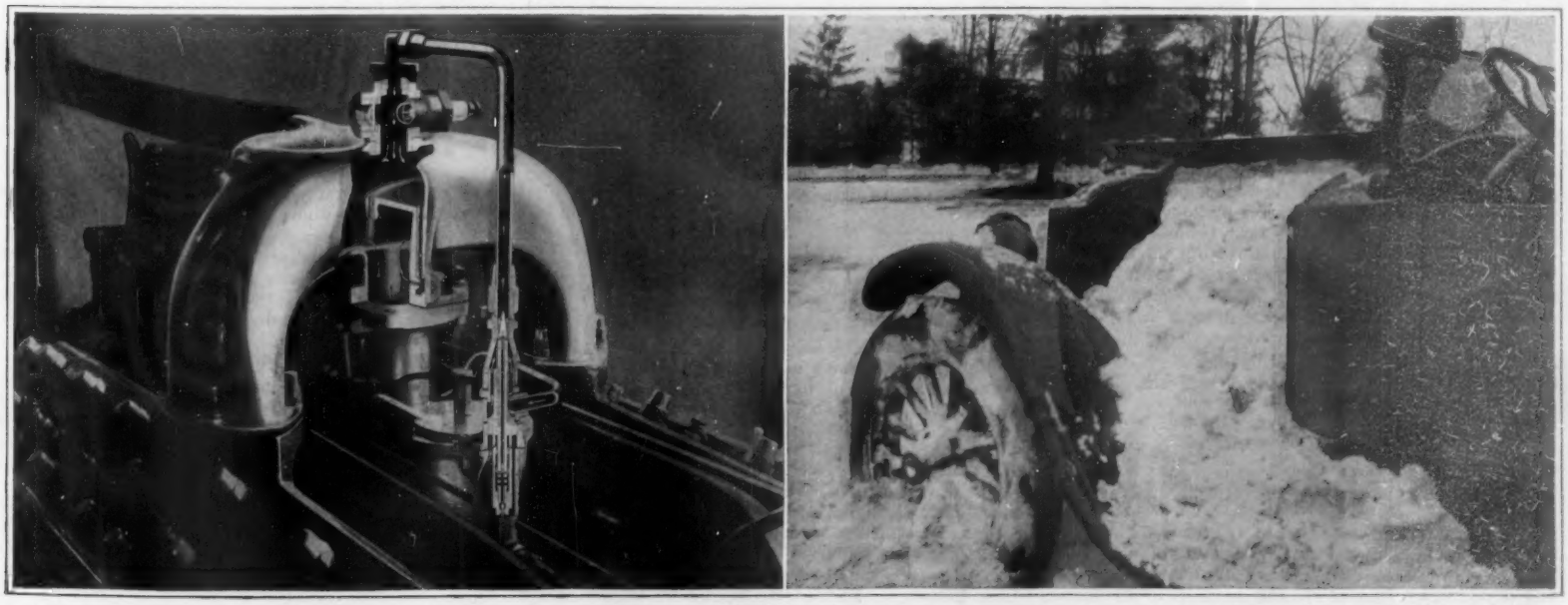


The new vaporizer that enables the carburetor to function with the same efficiency in all seasons, broken away to show its construction; and a sample of the weather in which it was tested and found to work well

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Science and Export

THE difficulty which scientists have always had in securing the genuine interest of manufacturers in applying the results of the laboratory to industry is proverbial; but the time has now come when we have reason to believe that industry will look upon these matters very differently. In many cases our manufacturers, who could employ chemistry, physics, and other sciences to great advantage, have been satisfied with the domestic market and unfortunately have found it more to their liking to remain behind high tariff walls than to practice small economies which manufacturers in other countries have been in the habit of applying. The incident is recalled where a manufacturer was discussing with a chemical engineer the possibility of saving twenty per cent of his coal yearly by the use of proper and reasonable specifications. At the conclusion of the presentation the manufacturer is reported to have said that his annual coal bill was not more than $500,000 and that in his business twenty per cent of that sum was not to be worried about; but that if the chemist could find a way to save two per cent of his raw materials he would then be interested. Certainly the time is past when one can be indifferent to a saving of $100,000, especially in coal, and if we are to get into the world markets we must form the habit of carefully considering not only twenty per cent savings, but half per cent savings all along the line.

Ferrocerium

THE increasing use of ferrocerium is due to its pyrophoric properties. Hence its more popular name of pyrophoric alloy. Previous to the war the manufacture of this material, now so widely used in various types of lighters, was controlled by the Germans and Austrians, but for some time high grade material has been produced in this country.

According to *Le Genie Civil* of Paris, cerium is found in cerite from Sweden and Madagascar, and in monazite sands which occur principally in Brazil. By chemical treatment the thorium is separated from the other elements in these ores and the cerium, with other rarer elements, is separated out in the form of anhydrous chloride. This is decomposed by electrolysis into its elements, chlorine and cerium. The chlorine is liberated at the positive electrode. The cerium is fused in plumbago or iron crucibles, the negative electrode being constituted by the carbon. The alloy, ferrocerium, is finally prepared in refractory crucibles by the fusion of 30 per cent iron with 70 per cent of cerium, obtained by electrolysis and without further purification. The elements are fused at about 1,199° C.

When the alloy is fluid, it is poured into tubes of thin sheet metal and the sticks of ferrocerium thus obtained are cut into small pieces. One kilo of ferrocerium is usually formed into 5,000 flints, each of which is capable of furnishing a minimum of 900 sparks.

Buttermilk in Bread

ACCORDING to Dr. William Greick, there is a possibility for utilizing the considerable nutritive values in buttermilk in bread. A method has been devised for condensing buttermilk into a semi-solid, smooth substance, which has a consistency comparable to that of ice cream. Eight to ten pounds of this material, when added to a barrel of flour, is said to produce a loaf of far greater food value than bread without it. Buttermilk possesses certain vitamines of importance which impart an agreeable flavor to the bread. The sugar of milk, or lactose, remains in the buttermilk and combines with the dextrin in the flour to produce a brown crust at a comparatively low baking temperature, thus saving fuel and preventing unnecessary loss of moisture. The use of such buttermilk products would not only be economical and to the advantage of the housewife, but these gains would be greatly multiplied where bread is prepared on a commercial scale.

Zinc

THE American Zinc Institute arranged for Dr. George C. Stone to visit Europe and study the possibilities as regards the market for American zinc. His report has been made to the members of the Institute and in it particular account has been taken of economic and social factors abroad as well as the efforts being made to rehabilitate the zinc mines of Europe. For several years at least the United States seems to be the only country in a position to supply the European demand for slab zinc, although England and France offer little opportunity for zinc ore exports which, however, will be in demand in Belgium, Holland and possibly Germany.

The necessity is emphasized of being exact in exporting zinc products in standard foreign sizes, properly packed and accurately marked. There may be a good opportunity for the introduction of American finished roofing plates and in the reconstruction work it is expected that a large demand for sheet zinc will be developed.

It is also expected that lead-free zinc oxide and lithopone should also have a European export demand. Belgium is expected to react in every way more quickly than any of her allies and the note is made that while conditions there are far from normal, the optimism of the Belgians is in marked contrast to that of the other countries.

Distilled Water

DISTILLED water is coming into such wide use, as for example, in the maintenance of electric batteries for automobiles and other purposes, that the time seems ripe for emphasizing the desirability of having some standard for distilled water which should be prepared and sold under conditions that guarantee its quality to the purchaser. Too few of those who dispense distilled water are familiar with the characteristics which the fluid should have and with the considerable number of impurities which should be eliminated. These include mineral matter, oil, ammonia, carbon dioxide, fixed alkalies, nitrites, chlorine, copper, and iron. Apparatus for preparing distilled water should never be forced and it requires careful flushing and washing if it is to continue to deliver satisfactory water. Even the selection of a raw water supply for distillation is important and the containers in which it is kept and sold must be carefully selected. For scientific work the question of a container is frequently a serious matter, since glass is somewhat soluble in distilled water, at least to the extent that some of the ingredients dissolve out in amount sufficient to interfere with exact determinations.

Borax as an Alloying Agent

FOR some times there has been a demand for more information regarding the effect of so-called impurities and the presence of small quantities of the rarer metals upon such alloys as those of brass, copper, and aluminum. There have now been patented alloys of boron which seem greatly to improve various metals from gold to steel. Their use is said to effect great economy in that they have a cleansing and hardening effect upon the metals to which they are added, giving additional strength and rendering alloys more homogeneous and uniform, greatly improving their texture. Castings are said to be more free from imperfections, and one advantage is that ordinarily from 1/10 of 1 per cent to 2 per cent of boronic copper or other boronic alloy is all that is required to obtain results which continue to be beneficial even when the metals are melted as scrap.

Monel Metal

A BOOKLET on this alloy has recently been issued and gives a great deal of interesting data. That an ore, which might otherwise have presented a problem in refining, should have been found to yield a metal with so many important characteristics is fortunate, and constitutes another argument in favor of research and careful experimentation. Monel metal contains approximately 67 per cent of nickel, 28 per cent of copper and 5 per cent of other metals. It is tough and ductile, and can be machined, forged, soldered, brazed and welded. It has high tensile strength, resists corrosion and deoxidization, even in the presence of hot gases and superheated steam. As scientific data and results of practical experience are placed in the hands of engineers, a continually increasing variety of uses is found for this interesting alloy, and in some industries, such as dyeing, entire machines are now being constructed wholly of Monel metal.

American Property in Germany

THE Alien Property Custodian's report answers a question that has often been asked—"What has Germany done with American property in the German Empire?" According to the report, she has done just as we have, keeping constantly a little ahead of us and protesting that she has resorted to liquidation and sale only as a matter of reprisal. With this excuse, she liquidated or sold American property before the general power of sale was conferred on the Alien Property Custodian by act of Congress. She has sold the property of American and neutral residents in Germany down to the household goods and wearing apparel which has never been done here; she has organized corporations under official control to purchase at ridiculous prices, syndicate and control all the plants in certain industries having French, British and American interests—all before similar action was taken in the United States and allied countries. It has been a sort of retaliation before the fact.

This may serve to correct any misapprehension which some may have had regarding the propriety of methods followed in acquiring German patents and administering them under the Chemical Foundation, which is now taking such an important part in the efforts to firmly establish our American chemical industry.

Lectures in Chemistry

IN the journal of *Industrial and Engineering Chemistry* for December is given the list of lectures to be given by prominent members of the American Chemical Society at the Military Academy at West Point and the Naval Academy at Annapolis. This recognition by the military establishment of the importance of chemistry to them is naturally gratifying to the chemical profession, and the effort has been to present in these lectures a broad program which would be of greatest use to the graduate students. Some of the subjects are: Sulphuric Acid, the Pig Iron of Chemistry; Manufacturing Problems of Gas Warfare; Nitrogen Fixation and Its Relation to Warfare; The Amorphous State in Metals; Explosives; The Utilization of Research; Natural Resources and Their Relations to Military Supplies; Organic Research in Toxic Gases; Iron and Steel.

Yeast Stimulants

CERTAIN researches on breads undertaken at a time when their saving was of even more importance than at present, have given results which have a present-day importance, although it must be pointed out that there is no unanimity of opinion as to the value of these stimulants and their real action upon the dough. One school maintains that it is wholly a question of changes in the gluten, thereby making it possible to produce a good-looking loaf from cheap flour, while the other school produces data to prove substantial savings. One of the compounds which has been devised for this purpose consists of ammonium chloride, potassium bromate, sodium chloride, calcium sulphate, and flour.

In baking one thousand loaves, each weighing one and a half pounds, the following weights of these substances were used: 1.23 pounds of calcium sulfate; 0.48 of ammonium chloride; 0.01 of potassium bromate; 1.23 of sodium chloride; 1.97 of flour. The savings realized were as follows: 9.50 pounds of flour; 4.19 of sugar; 1.19 of salt; 5.80 of yeast. Further experiments are under way to confirm these data and to ascertain also whether any detrimental effects are caused by these materials.

Anhinga

THIS fiber, which occurs in Brazil, seems destined to play an important part in industry. Comparatively small quantities have thus far made their appearance, but the fiber is said to be suitable for the production of paper similar to that obtained from linen and to serve as a raw material for the production of a cotton-fiber substitute superior to cotton in some respects. A new process has been devised for the treatment of the fibers to make them suitable for textile purposes and at least one mill is reported to be producing something more than one thousand pounds of the treated fiber daily.

Left: Making a big descent without any special elevating sections. *Right:* Weighing on the fly. *Below:* Packing electric lamp bulbs with the aid of a conveyor.

Three unusual conveyor installations

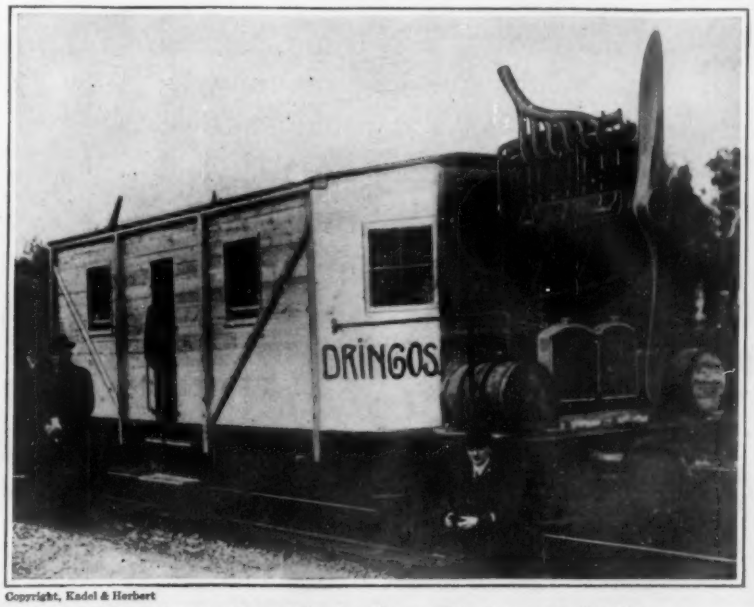
Interesting Uses For Conveyors

MECHANICAL conveyors are made to meet practically every transportation need that can arise in the modern manufacturing plant. They can be permanently installed, with rigid foundations, or they can be secured in portable form, easily moved from place to place and of a length and width to meet all requirements. And one is tempted to say that anything can be carried by these mechanical marvels. Boxes, barrels, rolls of paper, castings, brick and tile, lumber, in fact all products having at least one flat surface, can be carried directly on the conveyor. Small machine parts and a wide range of items which represent the same transportation problem as do these are carried in "tote boxes"; bags of cement and grain, rolls of cloth, and other products of irregular shape are carried in simple trays or containers of one sort or another. Even so delicate a load as a stalk of bananas is not beyond the range of the conveyor, but is trundled from ship to warehouse by one which presents a sagging surface between its ribs, so that instead of being a flat belt it is a series of travelling pockets.

Also we have gone far beyond the primitive conveyor, which was good only over a straight stretch of uniform pitch. Curves and switches may be made as flexible as in a railroad track; in many plants the conveyors are run through partitions and around columns and other obstructions, winding their way about through a floor full of machines, and carrying the load wherever it is wanted. Special modifications of the conveyor are offered for lowering material from one floor to the next; and these deliver their load to and receive it from the more ordinary conveyors, without the interposition of any human hand. The case may be summed up by saying that wherever a man can carry and deposit a burden, there the conveyor can deliver it, and more cheaply.

Nor are conveyors only of value in the transportation of material to and from storage. The conveyor engineer does not stop with delivering the material to the department that wants it; he goes further than this, and delivers it to the man and the machine that want it, so that there is no unloading the conveyors and trucking their loads about the floor. The conveyor distributes its load by retail as well as by wholesale. And in so doing it not merely cuts the cost of common labor like floor boys and porters—it actually speeds up to an extreme degree the work of the skilled machine hands. In many factories machines are assembled on the conveyor, passing the workers at a fixed speed and receiving a slight touch from each worker so passed, until they are finally complete. An interesting case of this sort of thing appears in one of the pictures herewith, where packed boxes are weighed as the conveyor carries them across the platform of a scale.

Another of our photographs shows an installation of great interest because of the way in which an ordinary conveyor descends from one level to the next without the use of any elevator section—simply by winding around the big columns that support the ceiling. This picture comes from a big bottling establishment, and shows the cases of drinkables on their way to the stock room or the shipping platform, after having been nailed up. Doubtless the latter operation takes place on the belt itself. Finally we show the conveyor which carries electric light bulbs from station to station in the packing room of one of the big factories. Each man claims the case of bulbs as it comes to him, does his bit toward getting it ready for shipment, and passes it along to his neighbor. This is a far cry from the old system which involved a regiment of boys to shove the cases about the floor in hand trucks, or to shunt them from table to table by means of the good old standby, elbow grease.



Copyright, Kadel & Herbert

With airplane motors at front and rear, this German railroad car makes 50 miles an hour

Airplane Engines as Railroad Locomotives

THE accompanying illustration, which has recently come from Germany, reveals a curious line of experiment which is being followed in that country. A car especially built for experimental purposes and to run on a standard gage railway track, was equipped with two standard airplane engines and propellers. The engines are of the 6-cylinder type, and most likely of 275-horse-power rating, which gave such excellent service at the front. One engine is mounted above the front platform on which are two barrels of fuel and apparently two automobile radiators which have been pressed into service, and the other engine and similar equipment is over the rear platform.

No attempt has been made to streamline the car further than the cutting off of its forward corners so as to give an approximate wedge-shaped front end. The information that has reached us states that with forty people aboard, this car attained a speed of fifty miles per hour. If this be correct it is certainly remarkable, when we bear in mind how greatly the car must have interfered with the free flow of the air from the propellers. Ordinarily, where an attempt has been made to drive vehicles by means of air propellers, the latter have been placed well above the car for the purpose of obtaining good efficiency. The design of the car was due to Alex Pfeiffer, who sought in this way to lessen somewhat the coal consumption during the great shortage that obtained in Germany at one time.

A Helpful Organization in Argentina

AMERICAN manufacturers, exporters and importers interested in Argentina should communicate with the Camara Sindical de Comercio, Avenida de Mayo 665, Buenos Aires, a chamber of commerce composed of leading business men. This organization offers to place American firms in touch with Argentine houses. It does not undertake the purchase or sale of merchandise nor does it accept commissions, having been formed solely for the purpose of establishing close relations between buyers and sellers and of increasing the foreign trade of Argentina.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

An Emergency Truck for the Fire Department

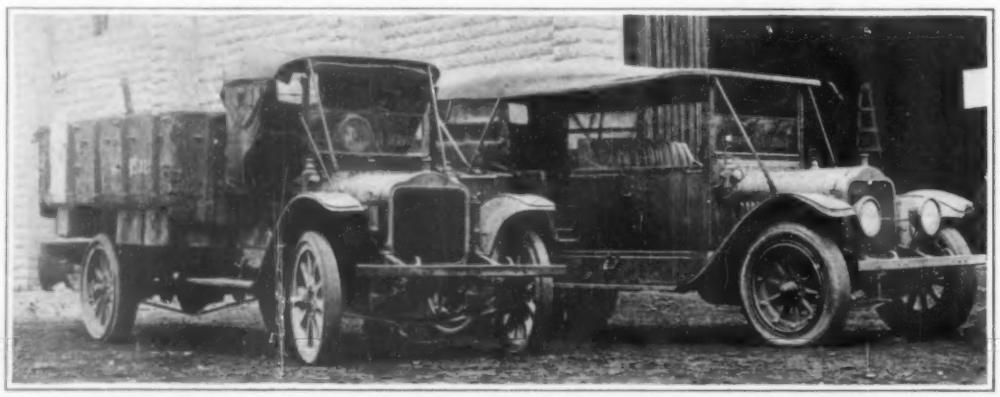
THE tendency noted in our large American cities to motorize the fire department apparatus is especially noticeable in New York where special apparatus of all types is used in large numbers. In order to maintain service and take care of damaged apparatus, a special wrecking truck has been designed that can cope with almost any emergency. Its construction is clearly shown in accompanying illustrations. The rear view shows the winch drum and special telpher arm which can raise heavy apparatus by the engine power of the truck.

The special equipment is carried by a standard motor truck of 5½ tons capacity, and in addition to the wrecking equipment, it also carries fire fighting material such as extinguishers, axes, etc. Special jacks are hinged to the back of the frame so the load can be taken from the chassis springs when heavy weights are lifted. The traveling telpher carries a block and hook and strong wire cable is used in connection with the winch. Tool cabinets are placed at each side of the body, the tops serving as work-benches and having substantial metal workers vises attached to each bench top. All kinds of metal working equipment and tools are provided and the vehicles can be used either as a wrecker or as a repair truck.

New York's Emergency Fire Department truck, and a rear view showing the gear for raising heavy apparatus that has been disabled

The Truck Auxiliary of the Aerial Mail Service

THE motor truck, long recognized as an essential transportation medium for the rapid dispatch of mail between postoffices, substations and railway terminals, is proving to be equally essential in the development of the aerial mail service. In maintaining daily air mail service between Cleveland and Chicago, standard trucks are used to dispatch mail between the postoffice and landing field. They enable a late closing of the air mail and insure the planes "hopping off" on time. The illustration shows the type of trucks used to transfer mail at the Cleveland landing field. The truck rushes the mail through the business district of the city to the postoffice, four miles distant, in fifteen minutes. The aerial mail service officials selected trucks for this exacting work because of the long established record of the type shown for dependability. Another vehicle of 1½ to 2 tons' capacity is used at the Cleveland landing field as an emergency truck to carry supplies of fuel and airplane parts to the hangar. Mail transported over the new air route is delivered within five hours after being posted in Cleveland or Chicago, and much of the credit for this showing must be given the truck that reduce transfer delays to a minimum.



Trucks that form the connecting link between the Cleveland post office and the mail planes to and from Chicago

Special Jack for the Semi-Trailer

MENTION has been made in these columns of the advantages obtained by using one tractor in connection with a number of semi-trailer bodies to move goods economically, the idea being to keep the tractor in commission by shifting it from one semi-trailer to another while the bodies are being loaded or unloaded, thus eliminating lost time on the part of the power plant and driver. The views herewith show a special type of jack used to support the large semi-trailer bodies to permit the tractor to be attached to or detached from the load carrying body. The bodies are used by a wood box manufacturer for handling box shooks, lumber and finished material and as considerable time is consumed in loading and unloading owing to the nature of the material the special jack shown makes it a relatively simple matter to raise the body, support the front end of the tractor, and release the power plant for duty in hauling another semi-trailer while the load is being transferred from the stationary one.

Using the special jack that frees the tractor from the semi-trailer and supports the latter during loading or unloading

Brakes on Trailers Desirable

THERE has been an increasing use of trailers in connection with trucks and truck-tractors and as the practice appears to have given satisfaction, there is every likelihood that it will receive wider application. It has been puzzling to some observers that designers of trucks should provide so much excess power in their engines that they pull not only the truck and its load, but also one or two trailers with a load equal to that carried by the truck itself. The reason is, that manufacturers must design their trucks to be capable of carrying their load under the worst conditions of hills and bad roads and, if they have sufficient power for this, they have a surplus of power for operating under normal conditions.

One problem in connection with the use of trailers that deserves more attention is that of proper braking. Not only is it necessary that the brakes be capable of holding the trucks and trailers with full load on the steepest hills, but a quick and positive stop should be possible in case of an emergency. Motor vehicles are used very often in congested thoroughfares and the ability to make a quick stop in an emergency is of the greatest importance. In the past, the rear wheel brakes of the truck alone generally have been depended upon for stopping the whole train, but it is evident that this plan is not very effective or reliable.

Railroad experience has shown that, in the case of a train, it is necessary to exert braking effort on all of the units composing it to secure reliable braking. The same practice will probably have to be followed in the case of road trains composed of a truck and several trailers, if these trains are to be operated with safety. A law has been passed in California, requiring all trailers to be fitted with

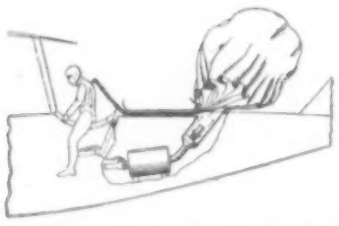
(Continued on page 206)

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

PARACHUTE-LAUNCHING DEVICE.—S. J. KEMPIN, 1306 2nd Ave., So., Minneapolis, Minn. The aim of the invention is to provide a parachute particularly applicable to flying machines, and to provide a structure associated with the parachute whereby the same will open before a load is even placed

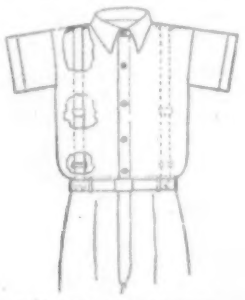


VIEW SHOWING PARACHUTE IMMEDIATELY AFTER OPERATOR HAS SET THE APPARATUS TO FUNCTIONING

upon it, so that in case it should become necessary to utilize the device close to the ground it will instantly open. A further object is to provide a parachute which is normally out of sight and in which the suspending cables are attached to the operator of the machine.

Pertaining to Apparel

GARMENT.—J. O. LINDEN, St. Joseph Sanitorium, Albuquerque, N. M. The invention relates to a combination garment for work, the general purpose being to provide a garment comprising trousers and a blouse together with suspenders secured to the trousers at the



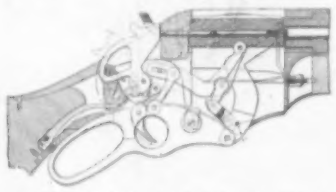
A FRONT VIEW OF THE GARMENT, PORTIONS BEING BROKEN AWAY

interior of the blouse, such garments answering the purpose of overall suits while presenting a much better appearance and affording more freedom of movement to the wearer.

Of General Interest

SUBMARINE BATTLESHIPS.—A. W. CRONENBERG, 751 Thrale Place, Woodhaven, L. I., N. Y. The invention relates to a type of vessel which is capable of partial or total submergence in water. Among the objects is to provide a submergible having water-tight compartments adapted to accommodate ordnance pieces which can be manipulated and discharged from said compartments, the compartments being accessible from the interior of the submergible. A further object is to provide a wide beam providing a large water space amidship for resisting the recoil of guns.

GUN-ACTION.—L. B. HOCHSTEIN, 22 North St., Endicott, N. Y. Among the principal objects of the invention are to provide for a safe breech closure, to provide for surety of action, and rapidity of fire; to facilitate holding sights on target while operating action, to permit the use of long cartridges, to fa-



A SECTIONAL VIEW OF THE INVENTION

cilitate the loading and reloading. The construction is such that the action may be worked without removing the hand from the grip, and that action cannot be accidentally jammed or even by purposely placing a cartridge in it in reversed position.

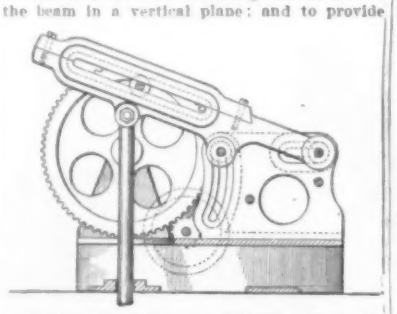
PLANT GUARD.—A. W. HARRIS, Sleepy Eye, Minn. The invention relates to garden implements and devices; its object is to provide a plant guard made from a single sheet of cardboard and arranged to permit of readily placing it in position around a young growing plant to prevent cutworms and other insects from reaching and injuring the plant. Another object is to provide a guard which when in position is not liable to be disturbed by severe winds or rain.

WASHBOILER RACK.—E. L. SCHLEKAU, c/o H. Schlekau, Southside St., A. F. D., No. 3, Omaha, Neb. The invention relates to means to be placed in a wash boiler on top of the clothes to hold the latter securely pressed down during the boiling operation. The prime object is to provide a rack formed of separate frame sections so connected as to provide for facility of adjustment for varying the length of the rack to suit boilers of different sizes.

ANIMAL HEAD.—B. COHEN and M. LICHTENSTEIN, 41 W. 28th St., New York, N. Y. The object of the invention is to provide an animal head for fur scarfs and similar fur articles, and arranged to enhance the ornamental appearance of the fur article, at the same time provide means for temporarily engaging the head with a portion of the outer garment of the wearer. Another object is to insure the formation of a clamping head which is simple and not liable to get out of order.

Machines and Mechanical Devices

PUMP.—A. CARD, c/o J. Washby, 880 N. Andrews Bldg., Los Angeles, Cal. The general objects of the invention are to provide a pump in which the walking beam is so mounted and actuated as to vibrate on a center shifting to and from the vertical line of the pump rod in addition to the vibrating movement of the beam in a vertical plane; and to provide



A SECTION SHOWING THE WALKING BEAM APPROXIMATELY AT THE END OF THE UPSTROKE

guide means for the beam in its vertical vibratory movements and for the pin constituting the shifting center, whereby the pump rod will be given a direct rectilineal reciprocating movement without friction and without guide means for the rod.

Railways and Their Accessories

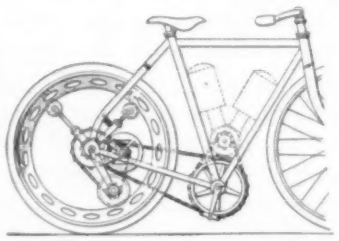
SAFETY DEVICE FOR RAILWAY SWITCHES.—W. J. BURKE, 2532 Hellman St., Youngstown, Ohio. The invention relates to a safety device more particularly to the combination with a track switch of a movable member adapted to be actuated by a wheel traveling on the track, and means for operatively connecting this member with a switch point, whereby when the member is actuated the switch point is forced home to a completely open or a completely closed position, according as its initial position is nearer the open or the closed position.

Pertaining to Recreation

SHOOTING GAME.—C. L. BREMER, 60 State St., Boston, Mass. The object of the invention is to provide a game embodying a board upon one end of which is disposed an imitation cannon or other fire arm so mounted that it can be turned horizontally to aim at any one of a row of soldiers disposed in front of a redoubt structure at the other end of the board. An important object is the provision of a device in which all the apparatus for knocking down the soldiers is concealed, so as to mystify the operator as to the means employed.

Pertaining to Vehicles

BICYCLE OR TRICYCLE.—J. A. MYERS, 11715 Orville Ave., Cleveland, Ohio. This invention has reference to power-driven vehicles in general, and particularly to bicycles; its object is to provide a driving mechanism wherein power is stored in an inertia element to contribute to the steadiness of drive, and



A SIDE ELEVATION OF A BICYCLE EMBODYING THE INVENTION

wherein a spokeless drive wheel may be employed, whether such drive wheel be of the single or double type. The invention comprises a driving mechanism lodged in and forming sustaining means for the rear or driving wheel or wheels.

AUTO SIGNAL.—L. J. RICKARD c/o Elks Club, Akron, Ohio. The invention relates particularly to auto signals for indicating the direction in which a vehicle is about to turn An object is the provision of a signal comprising a movable indicating arm formed of a plurality of foldable sections, whereby the arm when not in indicating position can be compactly folded so as to occupy a small space and thus not interfere with the operation of the automobile.

RADIUS ROD.—J. D. BRIDGERS, Florence, S. C. The invention relates to radius rods for automobiles. One of the principal objects of the invention is to provide a radius rod, so made that a single spare arm carried in the car may be quickly put on in place of either arm of the rod which might become bent or broken when out on the road. Another object is to provide a separable anchor member for connecting the inner ends of the rod arms to the engine casing, which anchor member may be readily replaced by a spare one if damaged.

DIRIGIBLE HEADLIGHT.—R. DE FILLIPPIS, 435 Rodney, St., Brooklyn, N. Y. This invention relates to headlights or searchlights for general use, and headlights particularly adapted for use on road vehicles such as automobiles. Among the objects is to provide automatic means for turning or steering the headlights laterally coincidentally with the ordinary steering of the machine or vehicle so as to insure that the road will be illuminated properly in front of vehicle irrespective of the turns that may occur.

BRAKE MECHANISM.—E. A. DIETRICH, 910 Caldwell Ave., Bronx, N. Y. An object of this invention is to provide a brake mechanism more especially designed for use on automobiles and other vehicles and devices and arranged to insure a quick, slow, or graduated application of the vehicle brake in an exceedingly economical manner and without producing undesirable vibration. In order to accomplish the result use is made of a spring motor, a clutch, a planetary gearing, and actuating means for moving the clutch members in and out of engagement.

REFUSE COLLECTING TRUCK.—O. C. KNIGGE, 29 Bradhurst Ave., New York, N. Y. The principal object of the invention is to provide a device in which suitable containers carrying the material collected, may be elevated to the top of a wagon or truck and dumped thereon, and to provide means for dumping the containers, and automatically returning the receptacles to the filling position, the pumping mechanism being folded out of the way when not in use.

TIRE TREAD.—L. SCHISSEL, 1549 Broadway, Brooklyn, N. Y. The object of the invention is to provide a detachable tire tread which may be applied to a tire to extend the life thereof. The device comprises a plurality of adjustably connected strips overlapping one another, retaining brackets carried upon the tread retaining strips and adjustable transversely, traction lugs secured to the adjustable strips and to the retaining brackets.

ATTACHMENT FOR PNEUMATIC TIRES.—S. J. STEIN, Greenwood, Miss. This invention relates to non-skid, puncture-proof protectors adapted to be applied to pneumatic tires. An object is to provide a protector composed of annular series of plates having non-skid elements and hinged together, certain of the hinges being formed to prevent end members adapted for connection with the elements employed for fastening the protector to a wheel.

AUTOMOBILE TIRE.—H. G. CAVE, 37 Maiden Lane, New York, N. Y. One of the principal objects of the invention is to provide a non-skid tire, means being afforded by which to prevent slipping of the tire on roads or streets in wet weather, which will secure a good purchase against a surface of dusty roads in dry weather. The invention involves the use of a plurality of blocks of artificial stone set at spaced intervals in the tread of the tire, the arrangement being such that the blocks may be removed, when worn for replacement.

CARRIER FOR SPARE TIRES.—A. E. FELDMAM, 106 7th Ave., New York, N. Y. The general objects of the invention are to provide a tire holder and carrier that will completely house the tire and thereby fully protect the same, and to provide a cover for the holding means having fastenings permitting the cover to be readily fastened or unfastened, the casing body being adapted to be secured in fixed position on the side or back of an automobile, centering means being provided for centering the tire and facilitating its removal.

STAND.—E. H. KELLEY and G. A. STEWART, JR., c/o Water St. Garage, South Brownsville, Pa. This invention has for its object to provide a stand, especially adapted for use in repairing and testing engine cylinder blocks, particularly of the "Ford" type. The stand is portable either with or without the engine in place, and permits the engine to be turned and held in the best working position. It in no wny interferes with the dismantling or assembling of the parts.

REEL.—T. L. MCNEELY, Colfax, La. This invention is particularly adapted to couplings for vehicles such as tractors and farm implements. An object is the provision of a reel of simple construction wherein a flexible member for coupling a propelled vehicle and a drawn vehicle can be fed out to vary the distance between the two vehicles or automatically taken up to effect a proper guiding of the drawn vehicle.

SHOCK ABSORBER.—G. W. CRABTREE, 111 4th Ave., N. W., Ardmore, Okla. The object of the invention is to provide means for use in connection with the springs of motor vehicles for assisting in the absorption and elimination of road shocks and jars, and for absorbing the jar caused by the rebound of the springs, and for preventing the breaking of the springs.

TRANSMISSION LOCK.—C. S. BROWN, 4343 Forsythe Ave., East Chicago, Ind. The invention has for its object to provide a device for use in connection with the transmissions of motor vehicles for locking said transmissions in neutral position. When it is desired to lock the transmission, a lever is moved into neutral position, at which time a papering opening will register with the bore of the lever. The knob is turned until the key registers with the passage and the knob is depressed.

COOLER FOR AUTOMOBILES AND OTHER RADIATORS.—S. BARUCH, 133 Mercer St., New York, N. Y. The invention has for its object to provide a neat and inexpensive cooler for automobile and other radiators, the cooler being provided with a drum with a plurality of disks with openings between which steam from the radiator will be condensed, the waters of condensation flowing back to the radiator.

Wireless and Everyday Business

(Continued from page 182)

their radio system when all other communications had failed was worth more to his company than the entire expenditure for the erection of stations.

Still another example is the radio system used before the war between the two establishments of a concern operating department stores in New York and Philadelphia. This system, an official of the company recently stated, was satisfactory in every particular and proved of great value in the organization. And, too, for many years the New York *Herald* has maintained a radio station in New York for maritime news work.

Many other varied and interesting examples could be mentioned here, but those cited are sufficiently varied and concrete to indicate that radio can serve and serve efficiently whether or not existing or possible wire can perform the same service.

While general statements of costs for radio installations are very difficult to make owing to wide variations in conditions, a very rough figure of $10,000 per hundred miles for overland stations may be assumed as sufficient for the necessary towers and equipment for reliable operation, but this may vary but fifty per cent according to conditions. For marine work where the ship stations require no towers and where less absorption of radiated energy is encountered during transmission the cost of installation is only of the order of $3,000 per hundred miles. These figures apply as indicated for two complete stations.

Reclaiming the No-Man's-Land of America

(Continued from page 183)

In southeastern Missouri one million acres have been drained. In Arkansas between 200,000 and 300,000 acres have been ditched and as many more are included in districts now under construction. So great is the scope of the work that it is said the state of Arkansas alone could employ every dredge boat operator in the United States and then some of the districts would have to wait.

In two large districts in Bolivar and Washington counties, Mississippi, 290,000 acres of land as rich as all the rivers that carry alluvium can make them, have been drained. The reclamation of the Florida everglades is being continued by the state of Florida, and plans are being made for the reclamation of more than half a million acres on the east coast. The states of North and South Carolina, Louisiana, Kentucky, and Georgia are dotted with drainage districts in various stages from projection to completion.

In the lowlands of Tennessee the work has gone on steadily for nearly ten years despite war and labor conditions, and farmers who for many years have eked out a bare existence from hillside lands while the rich lowlands remained idle are raising crops that will more than pay for the work that is being done.

In addition to rendering the land tillable, drainage improves the health of the community by removing the breeding places of the mosquito, and will probably result in eliminating malaria from this region.

The dredging machine used for reclaiming swamp land is known as the dipper dredge, and is similar in construction to the ordinary steam shovel except that the platform carrying the machinery consists of a barge instead of a car.

In the ordinary dipper dredge a mast or A-frame is mounted on the front of a barge and serves to support the top end of an inclined beam whose bottom end is fastened to a casting on the deck of the barge so that it can swing partially around like the beam of a derrick. Between the two parallel timbers of this beam is inserted a long timber carrying at its outer end a dipper open at the top and closed by a door at the bottom.

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Reclaiming the No-Man's-Land of America

(*Continued from page 198*)

This dipper is thrust down to the bottom of the ditch and given a scooping motion which fills it. The next operation is to raise the beam and by swinging it to one side bring it over the bank, when the door is unlocked and the contents discharged. By repeating this operation the bottom is excavated to such depth as desired.

Fastened to the dredging machine by means of stout ropes are the quarter boats where the workmen live. These quarter boats follow the machine from place to place as the work progresses.

Before the dredges begin operations, and after the land is surveyed, parties of workmen led by engineers go ahead clearing a right-of-way, chopping away timber and tangled undergrowth. This is perhaps the hardest work of all, as it is sometimes necessary that these pioneer axmen work in water above their waists. Sometimes, too, they must face the shotgun of an irate land-owner, who, confirmed in the habits of years, scorns modern improvements. Indeed, in more than one instance it has been necessary to wait months for the settlement of a lawsuit before work can proceed.

The cost of drainage varies from $10 to $30 an acre, spread over a period of years so as not to make the burden onerous. The cost of maintenance is nominal.

In the last ten years there has been an awakening to the opportunity that lies in the swamp lands of the South and Middle West, and a remarkable transformation is taking place. Drainage canals thousands of miles long are being dug; boisterous, misbehaving streams are being straightened and kept within their proper banks. In many places a ditch fifty feet wide is carrying the water that formerly filled a sluggish slough half a mile wide. Towns are springing up, and broad vistas of fertile fields are rapidly replacing the snake and frog infested lakes and quagmires.

San Francisco as a Fuel Oil Port

(*Continued from page 184*)

Each of these barges is operated by one man, and special precautions are taken so as to enable the operator to handle all equipment. As a safety precaution the fuel for operating the gasoline engine is carried in a 10-gallon tank located on the deck of the barge. Two powerful electric lights are provided on deck. They are of the goose neck type, and are provided with reflectors, held in such a manner that the entire deck of the barge is flood lighted, enabling work to be carried on at night as readily as during the day.

The main oil pumps are of the tandem duplex compound type, having a capacity of about 1,500 barrels an hour. Steam is generated by boilers located in the pump room. The exhaust steam from the pumps enters a special drum where the boiler feed water is heated to a temperature of 180 degrees. A novel feature is the arrangement for supplying oil to the 110-gallon fuel-oil tank for the boilers. A 1½-inch pipe leads from the cargo tank to the 110-gallon tank, and when oil is being pumped from the cargo tanks (into storage tanks of the company located along the San Francisco water front, not when oil is being pumped aboard a steamer) the engineer opens a valve which delivers oil also directly into the 110-gallon tank, thus saving an extra pump for this purpose. It requires about 85 barrels of fuel to operate the pumps while 3,000 barrels of oil are being pumped from the cargo tanks. Another novel feature is the fact that the oil pumps are connected with the bilge by means of a large pipe, and in case the barge should spring a large leak, the water can be pumped from the bilge by the regular oil pumps and discharged overboard. There is also a special duplex pump for use in case of fire, and for washing down the deck of the barge. The deck is washed down daily during the dry season. A 150-foot fire-hose is carried on deck on a special reel. This hose is of sufficient length to reach any part of the barge.

A derrick is provided at one end of the barge for handling the 30-foot sections of hose for making connection to the pipe lines leading to shore storage tanks and for connecting up to fuel oil tanks on ships. By means of this one man is enabled to swing the heavy hose around to the side of a ship and connect it up ready for pumping.

In the living quarters there is a galley, with a kerosene stove, on which the operator cooks his food. He has a porch on each side of the living room, and can put up an awning on one side to keep out rain or sun. Numerous life preservers are also carried on the house, as well as a fog bell, which the operator rings constantly during foggy weather.

One of our pictures is rather unusual because it shows a Japanese steamer taking on fuel oil and coal at the same time. The Japanese steamers are equipped with both oil-burning and coal-burning boilers. The ships coal at both ports, but get oil only at one end of their journey. So sufficient coal is taken on at San Francisco to run until the vessel arrives at Japan, where sufficient coal is taken on to last until the vessel reaches San Francisco; but sufficient oil is taken on at San Francisco to last the oil-burning boilers for the entire trip to Japan and then returning to San Francisco.

Hairs that Make Fabrics

(*Continued from page 184*)

knowledge of the form, structure, and interrelationships of the cuticular scales of most kinds of hairs, with the exception of certain types of wools where these elements are of unusual size and prominence. And in regard to the finer hairs used in the textile industry (such as those of the camel, alpaca and angora goat), the prevailing notion has been that when animal hairs become straighter, finer, and more filamentous in form, it becomes increasingly difficult to observe the individual scales, *not* because these may not be as plain and definite as those of sheeps' wool, but due to the suppositious fact that the individual scales fuse together, until the hair shaft becomes a smooth rod-like structure, devoid of any surface sculpturings. Nothing could be farther from the truth. The differences in form and structure of the medulla and the pigment granules seem not to have been made use of heretofore, though these also furnish excellent determinative criteria.

The preparation of many of the mammal hairs for ordinary examination is not laborious. Several hair shafts are taken and washed in a solution composed of equal parts of 95 per cent alcohol and ether or chloroform, to remove any oily matter from their surfaces. They are then dried in a current of warm air from an alcohol lamp; transferred to a clean glass slide, and covered with a cover glass. Examination can now be made directly, using the 8x or 10x ocular, and the 16 mm. and 4 mm. objectives. This simple treatment answers very well for those hairs whose cuticular scales are large and prominent, such as those of the various varieties of wool. In other cases the hairs must be washed in the ether-alcohol, as before, and then dipped with fine forceps into a solution of gentian violet in 95 per cent alcohol, of a degree of color depth which it is necessary to determine empirically for different kinds of hairs. (Other stains which go readily into solution in alcohol, *e. g.* methyl blue, methyl violet, Bismark brown, and safranin, can also be used. Frequently stains which give good results with one kind of hair will be much less satisfactory with another.) Such treatment ren-

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Hairs that Make Fabrics

(Continued from page 200)

ders visible the outlines of the individual scales of many of the finer hairs. However, even this manipulation fails with the finest hairs, and other methods devised by the writer—too lengthy for description here—must be called into service. The various treatments with caustic soda, caustic potash, and acids, hot or cold, often recommended, distort the scales, and render them valueless for accurate determinative purposes. The degree of success obtained with the microscope in the determination of scale sculpturings and other characters, often depends as much upon the intensity and colors of the light used for illumination, the position of its source, and the combinations of objectives and oculars employed as upon the previous preparation of the hair itself.

The various treatments used to render visible the cuticular scales all obscure the medulla, hence other methods must be employed to bring into prominence this element of the hair shaft structure. The simplest and most generally useful of these is to mount the hair on a slide in some one of the light oils used in histological work, such as oil of cloves, bergamont, peppermint, or cedar, etc., after having washed it, as before, in the ether-alcohol solution. With a few hairs it is sometimes satisfactory to use clear water as the mounting medium. Such methods are also useful to make clear the pigment granules of certain hairs. With others more lengthy treatments must be called into requisition, especially when the exact determination of the form of the granules, their mode of coalescence, and their relations to the component cells of the cortex, is the end in view. It is sometimes necessary to prepare transverse sections through the hair, for the purpose of more accurate observation of the pigmentation of the shaft, as well as for the determination of the contour of the medulla, and the form and placentation of its component cells and chambers. This is one of the most precise and tedious operations in trichologic investigation. Fig. 20 shows several shafts of human hair sectioned in this way.

For the various measurements made of theh air shaft or its parts, the ocular micrometer, with a moveable scale, is the most satisfactory. Since, in any given tuft of hairs, there are considerable variations in the size of the shafts or their structures, the average of several measurements, made at several definite points along the shaft, should be taken.

The captions of our group of drawings enumerate those species of mammals whose hair is the most extensively used in the textile industry, together with the number of the figure wherein is shown the microscopic appearance of the fur or under hair. The average diameter of the shafts of this hair, in micra, is in each case attached. In each figure two hair shafts are depicted; one treated to show the cuticular scales, the other to show the medulla. The various shafts are drawn as nearly to scale as is practicable in representing objects of such widely varying dimensions, so that a glance at the figures will afford some graphic appreciation of the relative sizes of the hairs. The figures of the hair of the horse (Fig. 10) and of the Virginia deer (Fig. 11) have been reduced in scale, however, and the figure of the hair of the intermediate bat (Fig. 19) increased.

Speaking of Tall Chimneys

(Continued from page 186)

the force of a hurricane. The maximum range of oscillation was 7.7 inches. As these oscillations were executed in 2.55 seconds, it follows that the maximum acceleration during the movement was 22.5 inches per second, which exceeds that of a semi-destructive earthquake. All this agrees, it would seem, with the excellent

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Speaking of Tall Chimneys

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behavior of concrete during actual earthquake shocks elsewhere—as, for example, in Guatemala.

What the losses have been and still are at smelting plants in general, it is impossible to say, except in a large way. The true gases pass out as part of the stack discharge. The vapors, however, are only partially ejected, since they are more or less condensed between furnace and stack-exit. This condensation is technically known as fume. What may be termed metallurgical dust also passes out from such stacks, if special measures are not taken to prevent. What the discharged values may be turns on various factors. One Montana smelter that gives forth one and one-third billion cubic feet of smoke per day is estimated as having discharged a daily total of 23,250,000 cubic feet of sulphur dioxide. From this gas, 3,400 tons of sulphuric acid might be made. Another smelter in Montana was estimated as losing in the form of its discharged dust a daily total of 3,775 pounds of copper, 106 ounces of silver and 0.71 ounces of gold. A reclamation system was put in at a cost of $1,100,000. It recovers a large part of the waste, the gross saving being estimated at $372 per day, or say $130,000 per year. Deducting 5 per cent of the original cost, there is still $75,000 to cover depreciation, maintenance and operation and provide a nice sum for distribution among the stockholders.

There is another side to this question of metallurgical smoke. A big stack is, say, a necessity to a smelter or similar works. It is part of the operating plant. Quite aside from the matter of waste is the question of damage. The stack may send broadcast over the surrounding country material of a nature that is positively injurious to the population or to the crops. Thus, in the South, near the common boundary of Tennessee and Georgia, the agricultural devastation accomplished by smelter smoke has been made the basis of Federal Court action against the industrial interests responsible for the damage. Some smelters seek to filter the gases through canvas or woolen bags. This procedure is expensive. The gases have to be cooled and the acid contents neutralized before reaching the bags in order to prevent their rapid destruction.

The Modern Gas Holder

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These columns or standards are for the purpose of guiding the holder, and the girders and diagonal braces act to transmit the enormous load occasioned by the wind on the holder proper through these standards to the tank shell. In this manner the entire structure is kept in a state of static equilibrium.

The holder proper is a cylindrical vessel, closed at the top and open at the bottom. It is made of sheet steel and is constructed to withstand the pressure of the gas from the inside as well as the wind pressure on the outside. Attached to the upper and lower edges of the holder are rollers or wheels. Those on the upper edge pass freely up and down the guide rail attached to the columns or standards, as the holder ascends or descends, and those on the lower edge act similarly on a guide rail attached to the inside of the tank shell.

The action of the gas holder is very simple. When the tank is filled with water, the holder is ready for use. Since the roof or crown of the holder is somewhat higher than the water level in the tank, the gas enters one of the vertical pipes and finds space to spread out under this crown. As the gas continues to enter, its pressure finally overcomes the weight of the holder and the latter begins to rise. In this manner, the gas provides room for itself due to its own pressure or force and the holder rises out of the water in proportion to the quantity of gas entering beneath it.

The water in the tank has a three-fold purpose; it is the means of resistance for the gas to lift the holder, it prevents the gas from escaping into the atmosphere, and it is also the means of expelling the gas through the other pipe when the holder descends.

Owing to the requirements of extensive storage space, expense of ground, and the limiting qualities of the material of construction, it is necessary to depart from the simple "single-lift" holder, just explained, and adopt what is known as the "telescopic" holder, which consists of an ordinary single-lift holder, called the upper or inner lift, surrounded by one or more cylinders of sheet steel similar to the side of the holder and of about the same height. The inner lift carries a "cup" on its lower edge, while the outer lift carries a "grip" on its upper edge, all being immersed in the water in the tank.

When the gas enters, the inner lift rises until its water-filled cup engages the grip of the next envelope, the latter then rising in conjunction with the inner lift. The gas is prevented from escaping at the cup and grip structure by the water contained in the former.

As a comparison of sizes and as an example of the immense strides made in holder construction, it may be mentioned that cylindrical holders were first constructed about 100 years ago. In 1817 a holder of 35 feet diameter was considered to be of enormous size. Thereafter, holders gradually increased in size until telescopic holders of 60 feet diameter and 36 feet high were made. These were considered the maximum size required for several years. In 1847 however, a holder was built in London with a diameter of 100 feet, and from then on the increase in size became rapid. The holder of 12,000,000 cubic feet capacity at East Greenwich, England, was the largest in the world until the advent of the 15,000,000-cubic foot holder at Astoria, Long Island.

The diameter of the Astoria tank is 300 feet and its depth below ground is 48 feet 3 inches. When fully inflated it rises to 252 feet above the ground. The 10,000,000 cubic feet holders mentioned above have a tank diameter of 273 feet and the top of the guide frame is 228 feet above the ground.

Agate Guides for Fishing Rods

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tries where fishing is much in vogue, because of the very slowness of the methods they employed.

The guides were all made up in the mountain country of Germany, where it was really a family proposition, a whole family drilling and grinding guides during the winter months by the crudest hand methods and then in the spring selling their winter's output to the commercial buyers, through whom it finally reached America. Uniformity and accuracy could not be maintained by so many different hands of more or less experience, especially under pressure of a large demand, and the result was that much inferior work began to be foisted upon the American market.

To hide the inferiority of their workmanship and the many blemishes in their guides, the German makers dyed them a deep dark red color by boiling them in an iron solution. This practice also enabled them to slip through many imitation agate guides, which were made of nothing but hard glass, and this was the more easily done because buyers had been led to believe that genuine agate guides should be red in color.

This was the situation when a Chicago lapidary of many years' experience, whose father and grandfather had been lapidaries before him in Amsterdam and who were familiar with the German methods of making guides, turned his attention to their manufacture on a modern scientific basis. The result of his efforts was the development of a remarkable mineral cut-

ting drill by means of which he is enabled to turn out large quantities of mechanically perfect guides in a comparatively short time, each guide being left the natural color of the raw agate.

This drill not only works with absolute precision, but will bore a hole of any desired size through a one-fourth inch slab of agate in from fifteen to twenty minutes. As against this, it took the German guide makers from fifteen to twenty hours to bore a similar hole through a piece of genuine agate, using for this purpose a so-called "bow" drill. This drill was operated entirely by hand and consisted of a stout piece of wood bent into the shape of a bow by means of a leather thong, which, in turn, was wound several times around a wooden spool four or five inches in length and half an inch in diameter.

In the lower part of the spool was fastened the drill which did the boring, while the upper part of the spool was fitted into a hole in a horizontal piece of wood three feet long and two inches square. This piece of wood was clamped at one end to another upright and stationary piece of wood, while the other end was held by the left hand of the person drilling and pressed against his chest. With the right hand he worked the bow in such fashion as to cause the spool to rotate back and forth, a few turns at a time, thus working the drill and eventually making a hole through the piece of agate. Only through long practice could a perfect hole be drilled in this manner, and the process, as may be imagined, was very tedious.

Agate is the hardest of all known minerals and the very hardest variety comes from certain volcanic regions in Uruguay. It is imported to this country through the American consul, who has it boxed and shipped to Chicago, the raw stones traveling some 6,000 miles before they reach the end of their journey. One box will often contain ten thousand dollars' worth of agate.

When a shipment arrives the guide maker examines each piece of stone carefully through a magnifying glass to locate any flaws and determine the best and most economical way of cutting it into slabs. A revolving circular steel knife is then used to cut the piece of agate into slabs about one-fourth of an inch in thickness. These slabs are then cut up into smaller pieces about an inch square. The small pieces are then fitted into the machine for drilling, the size of the drill used depending upon the size of the guide to be made.

When a hole is finally bored through a piece of agate it is next ground into a circular shape on a grindstone by hand. This grinding takes but a few seconds and the circular ring is then given a more exact shape on another grinding machine. The next step is to bevel the sharp inner and outer edges of the agate ring. Finally the rings are polished and mounted in metal holders, either as guides or tips, ready to be fitted to fishing rods.

The finished product is not only a delight to the angler's eye, but will insure longer life to his line and rod by reducing the rub and strain on them, respectively, to say nothing of making for greater accuracy in casting and ease in "playing" one's catch.

The All-Year Carburetor

(*Continued from page 189*)

grade fuel. It is a well-known fact that heat in proper degrees will give such vaporization and the problem has been the application of heat to the mixture of fuel and air as it passes from the carburetor through the intake header. One way of heating the intake is to enclose it by a water jacket. That system was quite satisfactory with fairly high-grade gasolene, but with the present low-grade fuel it was found that the heat so obtained was not sufficient. Another method is to

build the intake header in one piece with the exhaust pipe and obtain the average heat of the exhaust. The trouble, however, has been that the heat proves excessive when the engine is working hard, and not sufficient when the engine is started or idling. In other words, the intake header receives the maximum heat when it is least desirable, and a minimum or none when it is most needed. Another experiment was with direct electrical heating. This system proved totally unsatisfactory because of the weight and bulk of such a plant.

Some experiments had already shown that it was feasible to obtain heat for the intake header by burning a small amount of gasolene for this purpose only. The real problem was the application and regulation of this heat, without the use of a device that would entail adjustments and moving parts.

The result of experiments along this line is an appliance that works as an auxiliary to the carburetor. It is, to use an electrical term, a shunt around the main carburetor, and its operation is dependent upon the suction of engine. When the throttle is closed and the motor is turning over slowly, a certain amount of the suction is shunted through the auxiliary circuit. Air is drawn into the vaporizer, where a mixture of gasoline and air is formed; the mixture travels to a combustion chamber, which is situated in the intake header, and is ignited by a spark from a conventional spark plug. The hot gas that results from this combustion is then drawn into the fresh charge that is passing from the carburetor to the engine. The heat changes the wet mixture to a dry vapor, which is exploded instantly in the cylinders. It is interesting to note that the auxiliary system functions in a manner exactly opposite to that of the main carburetor: when the throttle is closed the combustion heater is in full operation, and when the throttle is open the shunt is practically inoperative. In other words, the combustion heater is giving its maximum service at the time when the engine needs the heated charge.

The action of the combustion heater is best described by following it through the performance of an engine. In the first place, the engine is at rest and cold. When it is turned over for starting, the motor is choked and the throttle is partially open. This causes a free suction of air through the vaporizer; the air mixes with the gasoline at its base, and passes through the pipe to the combustion chamber where it is ignited. The engine, being provided with a dry heated charge —without the usual loss of time and gasoline involved in warming up—is able to run on a summer setting within a few seconds.

It was not long ago that the problem of warming-up was considered nothing more important than a matter of personal inconvenience. But in these days when millions of people depend on automobiles for transportation the loss is enormous.

After starting the motor, the next stage in engine operation is idling. The throttle remains partially open, and the heat generated is not sufficient to warm the intake header by means of the ordinary exhaust heating system. The auxiliary, on the other hand, is working at its maximum efficiency during idling. As the throttle is opened, allowing a freer passage through the carburetor, the rush of mixture through the apparatus gradually grows less and less. When the throttle is wide open, it does not function. In other words, when, because of the natural engine heat, the ordinary heater is giving excessive heat, the auxiliary has ceased to operate. The engine heat, even with low-grade fuels is sufficient to make a dry vapor. For example, it is a well-known fact that the ordinary engine when hot will run on kerosene.

Months of experiment and test, which led to the adoption of the apparatus on a prominent make of car, show the following results: It is possible to operate the engine with a summer setting on the air valve in about twenty seconds from the time of starting, which means that the intake temperature has mounted to 120 degrees Fahrenheit in that time. Tests made at five degrees below zero show that the engine is able to pull on high gear almost immediately. During the months of experiment there was not a single case of a spark plug or valve fouling. The building up of kerosene in the crank case was almost entirely eliminated. Numerous tests show an absolutely clean exhaust, primarily due to the fact that the heater works at its maximum when idling. This does away with all excessive smoking except in case of excess oil when opening up the throttle after any considerable amount of low throttle work with a cool motor. The carbonizing of the motor is greatly reduced, which means not only a saving in the life of the motor, but a reduction of the wear and tear on the whole automobile, hitherto caused by uneven running. The small amount of fuel used in the combustion heater, is saved by the greater fuel economy of the engine, due to proper vaporization.

The vaporizer of the combustion heater is installed in an enlargement of the float chamber of the carburetor. Its operation is determined by the level of the gasoline, and, as has been stated above, is entirely automatic. Suction—shunted through this auxiliary system—causes the level of the gasoline to sink, disclosing holes by which the air may enter. The slower the engine runs, the greater the shunted suction becomes, and consequently, more holes are opened, allowing a greater charge to be taken to the heater. This is the equivalent to the opening and closing of the air valve in the main carburetor. As the throttle is opened, the shunted suction becomes less, and the gasoline level rises, shutting off air and reducing the mixture in the instrument.

The mixture that is carried to the heating chamber, passes through a restriction in the pipe, insuring against flareback, and through an atomizing screen, which gives it the proper diffusion for burning. The current for the spark plug in the combustion heater is supplied by a conventional spark coil and breaker, which are operated in unison with the regular engine ignition.

The novel feature in the burner is an observation window, so that the quality of the mixture can be determined from the flame. A perfect mixture produces a purple flame, a fairly rich mixture produces a bluish-green flame, and an exceedingly rich mixture is indicated by yellow streaks in the flame.

Brakes on Trailers Desirable

(Continued from page 194)

brakes, and it is not at all improbable that other states will pass similar legislation in the near future. This point was not considered in the regular motor vehicle laws of the several states as trailers were not in extensive use at the time those laws were drafted. At least three different braking systems are applicable to trailers. The first consists in the provision of hand brakes, which may be set by the driver before starting to descend a steep grade or by a special brakeman, who rides on the trailer. Setting the brake by the driver does not provide for emergency stops and a brakeman on the trailer is, of course, an important item of expense.

There is the air brake, which can be operated exactly as on railroads. There is a newly developed braking system known as the drawbar operated brake. With this, the compression of the drawbar, when the trailers coast as in descending a hill applies brakes on the wheels of the trailer, the force of application being in proportion to the retard-

ing force necessary to hold the vehicle on the grade. There is also compression on the drawbar in backing, when, of course, it is not desired normally to have the brakes on. This difficulty has been overcome by so arranging the linkage that the friction between brake drum and brake band during rearward motion will make it ineffective, which means that the brake will not function in case of a train backing down hill. Electrically actuated brakes have also been devised, these acting when the driver pushes a button, but these call for use of a current generator, which is not always found on trucks and rarely on trailers. The air brake system seems to offer the greatest number of advantages for providing positive and reliable control of truck and trailer trains.

NEW BOOKS, ETC.

A TEXTBOOK OF PHYSIOLOGY. By Martin Flack, C.B.E., M.B., B.Ch., and Leonard Hill, M.B., F.R.S. New York: Longmans, Green and Co., 1919. 8vo.; 800 pp.; illustrated.

With the primary object of furnishing the student with the fundamental facts and theories of physiology in understandable form, this solid work of English origin was started before the war. The authors have taken advantage of the delay to embody within it some of the remarkable progress made during the years of conflict. In plan, it takes a general survey of the science, proceeds to an account of the blood and the circulation of the body fluids, and follows with respiration general metabolism and dietetics, digestion, special metabolisms, functions of the kidney, the skin and the ductless glands, the tissue of motion, the nervous system, and reproduction. It is extremely well illustrated and, although addressed primarily to the medical student, contains many features of value to the general practitioner.

REYNOLDS' AFTER-WAR ATLAS AND GAZETTEER OF THE WORLD. Edited and revised by Francis J. Reynolds. New York: Reynolds Publishing Company, Inc., 1919. 4to.; 364 pp.; 251 maps; illustrations.

This fine collection of maps and geographical, commercial and military information takes note of all the new boundaries established by the peace treaties; its automobile maps show every good road in the country, and the motor laws of each State are outlined. Thirty-two railway maps indicate principal routes in the United States and Canada, indexed for use in connection with the gazetteer of cities and towns. The condensed war history gives all important events and features of the struggle. Its encyclopedia of world information includes geology, commerce, and industry, with photographs and relief maps. The gazetteer lists our own towns down to villages of 500 inhabitants; in the case of foreign towns, a population of 1,000 qualifies the place for inclusion. It will be seen that the plan of the work is sweeping; it only remains to be said that this plan has been admirably and artistically carried out to the last detail, resulting in a quick-reference atlas that will serve individuals in all walks of life and firms in all branches of industry.

THE LIFE OF MATTER. An Inquiry and Adventure. Edited by Arthur Turnbull, M.A., B.Sc., M.B. Philadelphia: J. B. Lippincott Company, 1919. 8vo.; 324 pp.; illustrated.

A vastly interesting book, teeming with arresting facts pictorially set forth, comes to us under the title, "The Life of Matter." In addressing himself to the average youth entering college, however, we are not sure that the author has not made a mistake. We can imagine the consternation of a pedagogue told that "Action and reaction are always unequal. The law of causation is incredible. Every form of matter is active and eternal, changing from within. Motion emerges." Despite the leaning toward Eastern philosophy as against Western conclusions, Western observational and experimental methods are upheld. The reader will acquire from the work an insight into most of the sciences, an appreciation of the pioneers, and a stimulus toward the acquisition of fresh knowledge.

AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By Dugald C. Jackson, C.E. and John Price Jackson, M.E. Revised and enlarged by N. Henry Black, A.M. New York: The Macmillan Company, 1919. 8vo.; 598 pp.; illustrated.

This text seeks to benefit both the student prepared by a year's work in physics and the man interested in knowing the how and why of electrical machinery. The illustrations and problems will enable the reader to interpret the law or

principle in practical terms, and the summaries and questions constitute valuable aids to a grasp and retention of the subject-matter. The manifold applications of electricity and magnetism are comprehensively covered, and the many excellent plates and figures portray the leading electrical scientists and the apparatus and instruments of their art.

ELEMENTS OF BUSINESS. By Parke Schoch and Murray Gross. New York: American Book Company. 8vo.; 216 pp.; illustrated.

Business habits should be inculcated in the young and should be practised in every home. The authors very rightly make a point of the personal, or family, cash account. The forms furnished are occasionally redundant and might in some instances be better fitted to individual requirements, but the principles and teachings are sound. The work develops the general principles underlying money and credit, banking practice, insurance, property, investments, and letter writing, and gives a well-chosen list of reference books. No pains have been spared to make every point clear to the mind unaccustomed to the details of business forms and operations.

FOUNDRY PRACTICE. By R. H. Palmer. New York: John Wiley and Sons, Inc., 1919. 8vo.; 390 pp.; illustrated.

This work, already favorably known to molders, apprentices, and students, has in its new form added information on propeller casting, the casting of locomotive superheater cylinders and slide valve cylinders, casting lathe beds, making cores for gas engine cylinders, and molding large kettles. The work is a textbook, leading the student from the simplest type of mold through to the difficult practice in green and dry sand and loam, and including cupola practice, mixing and melting, cleaning and repair of castings, and many other features with which the student should be familiar.

TECHNO-CHEMICAL RECEIPT BOOK. By William T. Brannt and William H. Wahl, Ph.D. New York: Henry Carey Baird and Co., Inc., 1919. 8vo.; 516 pp.; 78 engravings.

These carefully chosen receipts have proved valuable servants in the laboratory, the factory, and the household. The catholicity of the book's contents is remarkable, but all receipts and processes have one point in common—they have been selected, after exacting tests and trials, for their practical merit, and represent the last word in practice as accepted by the arts and industries. Alloys, beverages, explosives, metal-working, confectionery, dyeing, electroplating, these are but a few random items from the contents. Artist, artificer and handy-man may alike find almost anything they need to carry their desires to a successful end.

HENDRICKS COMMERCIAL REGISTER OF THE UNITED STATES. For Buyers and Sellers. New York: S. E. Hendricks Co., Inc 4to.; 2600 pp.

For the past twenty-eight years this Register has conscientiously served buyer and seller; each year has seen a marked advance in the quantity and quality of the service, and today it is conceded to be the most complete and reliable publication of its kind. The latest edition carries more than 100,000 names and has 1,200 additional trade classifications. Especial attention has been accorded the chemical industry; among other interests particularly favored are the iron and steel, mechanical, electrical, hardware, metal, mill, mining, quarrying, railroad, architectural, contracting and construction industries. There are full lists of producers, wholesale dealers, and the principal jobbers and consumers, and all products from raw material to finished article are represented. Another special feature is the list of machine shops and foundries the country over. The mode of grouping and integrating information is such as to enable the buyer to immediately put his finger on the source of any desired material, and the seller to promptly find the customer or outlet required. The work is not merely comprehensive; it is also strictly reliable; whether the need be to locate a manufacturer or discover new prospects, it may be depended upon to establish its value promptly. Among other uses to which it has been advantageously put is that of a cross index to the catalogue file. It is safe to predict that new subscribers will find the experience of older ones to be their own—that in a very short time the work will become the most used and most useful volume in their offices.

HOUSE PAINTING, GLAZING, PAPER HANGING, AND WHITEWASHING. By Alvah Horton Sabin, M.S., D.Sc. New York: John Wiley and Sons, Inc., 1918. 8vo.; 143 pp.

A book for the householder on the crafts of painting, glazing, and paperhanging, this new edition instructs the amateur in mixing his own paint and contains a number of formulas for tinted paints. That the paint body bears certain relations to economy and durability is a point never lost sight of. Full consideration is given to ready-mixed paints, which possess many advantages. The use of all sorts of preservative coatings, and the most approved methods of applying them, are set forth in simple language. The home lover and the hobbyist will appreciate the help here offered.

CAESAR'S GALLIC WAR. Book 1. With an Introduction by D. S. Elbon, A.M. New York: Translation Publishing Company, Inc. 8vo.; 231 pp.

This is a book of "The Fully Parsed Classics" series, containing the Latin text literally translated, with a full grammatical analysis and explanatory notes. Word by word, each sentence is resolved into its grammatical parts, so that the translation may be understood to the minutest detail. The upper part of every left page carries the complete original text, edited for school use; opposite, on the right page, is the translation, in which the construction of the original is preserved. The lower halves of the pages are given up to a critical examination of each word. The historical, mythological and geographical allusions are also explained.

THE RICHEY DATA SERVICE. Meridian Life Building, Indianapolis, Ind.: The Richey Data Service. Data pages, blanks, pocket binder and desk file.

In the Richey Service the loose-leaf system is extended and adapted to the needs of sales and advertising managers, agency men, wholesalers and retailers. The material is supplied monthly, with the first installment consisting of a hundred data pages, blanks, pocket binder and desk file. These up-to-the-minute data are to be employed as a framework on which the subscriber builds from his own experience and special needs; they parallel the field manual of the engineer. There are striking maps and graphs, and a commendable feature is the clear-cut manner in which all information is conveyed. Merely to mention the general headings of this information would exceed our space, but there are Business Condition and Outlook sheets, employment and strike statistics, advertising and sales facts, agricultural and manufacturing statistics, and a mine of material that, by means of the index, is open to instant reference. It is hard to conceive of a line of business that would not be helped by this service, while executives should find their value to their firms greatly enhanced by a knowledge of the important questions it so definitely answers.

AN ELEMENTARY COMMERCIAL GEOGRAPHY. By Cyrus C. Adams. New York: D. Appleton and Company. 1919. 8 vo.; 353 pp.; maps and illustrations.

The author of "A Text-Book of Commercial Geography" has prepared this elementary work for grammar grades. It presents a broad view of the world in its relation to man as a producer and trader, deducing from the concrete the natural laws of trade. Close attention is given improved transportation, the application of steam-power to various types of machinery, and the progress of industrial chemistry. The great trade routes followed by the chief commodities are plainly shown, and statistics are tabulated at the end of the volume. The presentation is able and attractive, and the practical treatment should appeal to our modern educators.

THE FORD STANDARD ELECTRICAL EQUIPMENT. Chicago: American Bureau of Engineering, Inc., 1919. 8 vo.; 139 pp.; illustrated.

This description and explanation fully covers the new electrical equipment now being placed on this popular make of car. The care with which the text has been phrased and the illustrations drawn should insure easy mastery of the problems arising, and will enable the repairman, and even the owner who does his own repairing, to make adjustments promptly and satisfactorily. There are numerous trouble and test charts, and cuts give the details of inside construction of devices. Simplicity and accuracy mark the explanations, which lay the whole minutiae of starting, lighting and ignition open to the reader. Troubles other than electrical are also touched upon in a helpful manner.

CAESAR'S COMMENTARIES ON THE GALLIC WAR. Books I-IV. New York: Translation Publishing Company, Inc. 8vo.; 143 pp.

In this convenient arrangement the original and the translation appear on opposite pages. Those desirous of renewing acquaintance with the classics may by this means refresh their memories and renew past associations; those who would study Caesar at home can find no better aid; and even the student in school, after having striven to the utmost to provide a correct translation from his own incomplete knowledge, may with benefit check his efforts with authoritative results.